THE POLITICAL AND ADMINISTATIVE CONTEXT OF ENVIRONMENTAL DEGRADATION IN SOUTH-INDIA

HOW CHANGES IN POLITICS AND PUBLIC ADMINISTRATION DETERMINE NATURAL RESOURCE MANAGEMENT BY INHABITANTS OF TWO VILLAGES IN A DROUGHT-PRONE AREA

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Centre for Environmental Studies
Leiden, The Netherlands

Willy Douma
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PREFACE

This report is the result of a six-months fieldstudy in a Semi-Arid region of South India during the period Februari - September 1987. The study was conducted by three students from different disciplines and universities. Ir. C.A. Drijver and Drs. G. Persoon of the Center of Environmental Studies, University of Leiden, the Netherlands, guided us during the preparation of the study and the writing of this report.

The initiative of the study was all ours. During a preliminary visit to India (September- October 1986) we succeeded in contacting eligible Indian supervisors. Dr. S.T. Somashekare Reddy (Indian Institute of Management, Bangalore) and Prof. J. Bandyopadhyay (Research Foundation for National Research Policy Dehra Dun) were willing to support us during our stay in India. With his great enthousiasm and his inexhaustible knowledge about village life, Mr. Somashekare Reddy introduced us into the villages and helped us to fight our ignorance.

But how to do fieldwork, without the full cooperation of the villagers? It is a great feeling when people welcome you into their villages, and give you friendly warmth and shelter, even despite our never ending questions. Without our translaters cum co-students it certainly was impossible to close the gap between Holland and Gatlagollahalli and Kanithalli. Miss Nirmula Puttana, Mr. Kullappa and Mr. Jayaram Reddy showed enough endurance to cope with our passion to know everything.

We certainly learned from our experiences with the villagers, and we hope that the children, women and men of Kanithalli and Gatlagollahalli feel the same. Special thanks and warmth go to Mr. B.C. Venugopal Rao and his family who have showed an unbelievable hospitality for us and our friends.

Also we want to express our gratitude to the Evert Potjer Fund and to those other funds which donations enabled us to execute the research.

Of course many other people supported our work and thought or struggled with us to fight. Few we can mention here, among them: Luuk Zonneveld, Hanne de Bruin, Peter Heikoop, Jan Brouwer, Mr. V. Parthasarathy, Mr. Siva Prasad, Mr. Mohammed Hussain, Mr. Pandurang Hegde and other members of the Appiko movement, Mr. Charles Fernandez, Mr. Rajni Kothari, members of the several Departments we visited, the Dryland Development Board, ICSSR, Data Center for Natural Resources (Mr. Johnson David and co-workers) and ISEC. We are sure that also those people whose names are not written on this sheet, will know that we are very grateful to them.

Willy Douma (Faculty of Biology, University of Utrecht).

Wim Kloezen (Department of Irrigation and Civil Engineering, Agricultural University Wageningen).

Paul S. Wolvekamp (Department of Political Sciences, University of Leiden.

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ABBREVIATIONS

AEE	Assistent Executive Engineer
BDO	Block Develpment Officer
DLDB	Dryland Development Board
DPA	Drought Prone Area
FD	Forest Department
LUS	Land Use System
MLA	Member of Legislative Assembly (State Parliament)
MP	Member of Parliament (Union Parliament)
O&M	Operation and Maintenance
PWD	Public Works Department
RD	Revenue Department
RFO	Range Forest Officer
Rs.	Roupees (Rs.13 = US$ 1,-)
SAT	Semi - Arid - Tropics
VA	Village Accountant

SUMMARY

Several districts in the State of Karnataka, like in most parts of India, are facing an environmental crisis. In this report the causes and social consequences of the two most pressing environmental problems in rural South Karnataka, viz: drought and deforestation, are examined. Severe water and biomass scarcity influence the whole chain of physical and ecological processes, which distortion leads to a decline of soil fertility. And then, each year the groundwater sources in the Deccan are getting further depleted. These problems of environmental degradation are accompagnied by increasing social marginalisation. It is the survival of the poor which is directly threatened.

The line of reasoning in this report is based on three prepositions. First of all, an understanding of how the protection and the maintenance of local natural resources is organised (e.g.: land-tenure relations, user-rights, the sharing of responsibilities and cooperation) is taken as point of departure. Secondly, that much can be gained when the analysis of the causes of the environmental problems concentrates on the identification and understanding of the changes within the social relations at village level, in particular changes within the structures of authority and cooperation with regard to natural resource management. Thirdly, the various interventions by the external political and administrative institutions are, among other factors, looked upon as possible underlying forces which produce the social conditions which lead to the lowering quality of local natural resource management.

Using these three assumptions as a general framework, comparative fieldwork was done in two villages during which an assessment of the environmental problems was made by identifying and quantifying the physical degradation and by studying the latter's causes as well as its impact on the basic needs satisfaction of different social-economic categories of households. By doing research in two villages in a drought-prone area it was possible to detect trends, as one village nearly reached the bottum of the slippery slope of environmental degradation, while the other village is still half way, but rapidly descending.

The fact that the rural Karnatakan society is going through a crucial transional phase, as it is rapidly entering the modern market economy while experiencing far-going social and political changes, makes that the sensitive balance between the villager and his/her natural environment is extremely vulnerable for external influences.

The breakdown of community participation, partly a direct consequence of the exposure of the village society to the outside world, is, for instance, a major cause of the overexploitation of tankirrigation, which at the same time, leads to a lack of maintenance of irrigation systems. On the other hand, there is an alarming depletion of groundwater sources through private well-irrigation. Indiscriminate felling and overlopping caused the further degradation of the village commons. Hardly any investments are made and lack of selfconstraint among villagers hinders the regeneration of the vegetation cover.

The external intervention is, at least, threefold. There is the introduction of new political and administrative structures and allied measures, like the creation of Mandal Panchayats and the transfer of the control over the village commons to this new body. The report amply illustrates

that such measures often carry the risk that the villager finds it increasingly difficult to identify with the new norms and structures. Then there is the wide range of governmental rural development programmes. Finally, there is the strong force of party politics.

The individual farmer who is (consequently) faced with a declining agricultural production, is encouraged by several government programs to role off his problems on his neighbour and on the future generation. Further, the state induced acceleration of the commercialisation of agriculture brings about several side effects. Now that several products get a cash value, there is a drain of primary products (milk, forest produce, etc.) away from the village to the (urban) market. The result is a less varied dietary menu for the villagers. Moreover, the cash oriented, short term, state policies undermine the traditional strategies of risk aversion with regard to food security under conditions of drought. The overall effect is that indigenous agricultural practices, which are based on time-proven principles of sustainability are often left behind.

The fact that rural poverty is still not perceived as a lack of access to basic elements of the natural environment - steeming from a disturbed balance between the villager and his natural surroundings -, is symbolic for the inadequacy of ruling official paradigms on development, of the many administrative weaknesses and of the prevalent political indifference.

We strongly recommend that much more attention is paid to the general need for integrated land-use planning, accompagnied by improved interdepartmental cooperation, doing justice to the interrelationship between the various natural resources.
Further, it is essential that the official training and administrative institutions strife towards a narrowing of the gap between villagers and government officials. While, at the same time, one can only hope that those in the political arena's show more sensivity to the need of sound environmental management, a precondition for the welfare of the people in the constituencies.
Finally, it should be prevented that indigenous organisation and knowledge get lost. Instead, serious efforts should be made to reach a synthesis between valuable elements of the indigenous heritage and that which modernity brings. It is in this context that we wish to emphasize the need to rehabilitate the immens irrigation potential of the many thousand of smaller tanks, many of which now suffer from neglect. Their repair and/or desiltation would be a major push towards a strenghtening of sustainable agriculture.

1 INTRODUCTION

India, like most developing countries in the Semi-Arid Tropics, faces a rapid degradation of its natural environment. Agricultural fields are liable to severe erosion; deforestation and desertification go hand in hand.
In 1987, villages in most districts of Southern India experienced one of the severest droughts of our century. Drought which induced further shrinkage and deterioration of their surrounding natural resources. A disaster for the majority of the population who live in rural areas and who depend for its livelihood on the exploitation of local natural resources.

In recent years it is becoming widespread knowledge that environmental degradation is mainly the effect of the unsustainable management of our resources. The Brundland Report 'Our Common Future' emphasized the growing global concern about the depletion of land- and water sources. Out of this concern more and more attention is given to technical solutions, but still too little attention is given to the social- and political causes of environmental problems.
Within the range of human activities it is possible to distinguish different types of natural resource management. Various groups of people, all with their needs and interests, have their specific impact on nature, through different modes of exploitation. Too often the villagers, especially the poor, are the ones who are most directly caught in the downward spiral of scarcity and overexploitation.
There is no technical fix which can solve the problem of the degradation of the natural resources. The main instruments of this degradation are often the disinherited from formely forested regions and the marginal farmers and the landless. But these are the agents, not the causers, their pressure on resources is steadily increasing as a consequence of a highly skewed distribution of private property in land and other resources (Westoby, 1987). This pressure will inevitably continue, until there is more equal access to land and other resources, which in its turn directly depends on political and administrative institutional factors.

The state has a major impact on local natural resource management. Through political and bureaucratic institutions, local people are influenced in their options with regard to the modes of local natural resource exploitation.
It is striking that, for instance, Rural Development Programs, which are supposed to be aimed to alliviate the social- and economic position of people who live in Drought Prone Areas, are characterised by their adverse impact on nature and man. Even when full priority is given to a sustainable relation between villagers and their surrounding resources, little attention is paid to the local people's problems and perceptions with regard to resource exploitation.
Local people should be regarded as the major agent of resource management, hence their position demands understanding and adequate support from the state. For this reason the relationship between state institutions on the one hand and the various sections of the rural population on the other hand should get full attention.

Degradation of natural resources must always be related to social changes (P. Blaikie, 1987). Scarcity of natural resources uncovers discriminate

access to land, water and other living resources and it also uncovers unequal distribution of the products of those resources. Political and administrative reforms, the introduction of new technologies and the penetration of party politics in the village, they all influence the social organisation of resource management at the local level. Communal resources exploitation is increasingly replaced by individual modes of exploitation. Certainly, for some groups in the villages, this individualisation may relieve their environmental problems, but it can be the cause of the marginalisation of other people who totally depend on communal natural resources.

Our believe that changes of powerrelations within the village effect the maintenance and distribution of local natural resources, gave rise to our urge to uncover their relation by means of two micro-studies of villages in the Drought Prone Area of Karnataka, South India.

By means of a six-months stay in two villages, we observed the organisation of both, indigenous and 'modern' modes of local natural resource management. As the changes of exploitation will influence the lives of those whose survival is most interwoven with nature, we decided to try to understand this relation from the grass roots. Only in this way it is possible to access the impact of political and bureaucratic intervention in the local struggle to relieve the pressure from ever increasing environmental problems. Our intention is not to propagate the slowing down of the processes of development or to rehabitate 'traditional' village society; as if the past society was so harmonious. Human exploitation and severe poverty still find their roots in the semi-feudal society. So there are reasons enough to change those relations. But still, too often changes in social structures introduced new forms of marginalisation and natural degradation.

It cannot enough be emphasized that the state of the environment in India may very well undermine the recent achievements in local democracy and the emancipation of the poor!

2 RESEARCH QUESTIONS AND DEFINITIONS

For this study we have formulated the following central research question:

In what way do politics and administration influence the management of local natural sources at the local level, and how can they contribute to a solution of environmental problems and the alleviation of the social consequences?

This problem is elaborated in specific sub-questions:

1. Which environmental problems can be identified in the two villages.
2. How can these environmental problems be translated in:
   a. physical degradation;
   b. marginalisation of the different categories of people within the chosen villages.
3. Which changes have been taken place in local natural resource management from India's Independence (1947) onwards.
4. In what way is the present management of individual, communal and state owned local natural resources organised.
5. How do the individual, communal and state ownership of natural resources each determine the access to local natural resource for different groups within the village.
6. Which political and administrative institutions influence the management of the local natural resources?
7. Which changes in the management of local natural resources are brought about by politics and administration, and how do these changes effect the quality of the natural resources and the position of the different socio-economic groups.
8. How do the involved political and administrative institutions respond to environmental problems and their social consequences.

For the following concepts we will give a definition: natural resources, natural resource management, environmental problems, politics and administration.

Natural resources: land, water and living resources and their products. We concentrate on those natural resources which are functional for agricultural, hunting and gathering activities for the fulfilment of basic needs and the raising of a marketable surplus.[1]

Management of natural resources: the whole complex of activities including decisionmaking and organisation of capital, labour and technologies for the extraction of products from and maintenance of natural resources. The aim of exploitation may differ among the different social-economic groups: for the fulfillment of basic needs or for raising a marketable surplus.

Environmental problems: the distortion of the relationschip between man and the surrounding natural resources. Thus, it is important to realise that the degree of distortion will always depend on the perception of

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[1] See also: Commission on Ecology and Development Cooperation, The Hague, 1980.

those people, who have an interest in natural resource management (see 3.4).

Politics: the whole of persons, institutions, organisations and procedures in a state, which is engaged in the acquisition, promotion, maintenance or the enlargement of administrative power (van Braam, 1985).

Administration: the determining of policies as well as the implementation there-off (van Braam, 1985). In this report administration refers to public administration: by the state.

3 THEORETICAL JUSTIFICATION

3.1 INTRODUCTION

The scope of this study is the relationship between political and administrative induced changes of natural resources and the changing social- and economic position of those people who are directly dependent on these local natural resources. We consider **Environmental Science** as a main instrument to examine the inter-relationship between villagers and their natural environment. Environmental Science takes the total **man-nature-system** as object of study. In our thesis we ask ourselves how this interaction is influenced by the external political and administrative environment. The man-nature-system can only be regarded as an open-system, which means: with sufficient space for integration of different social levels of interaction. But still. such an integrated approach, as any system approach, must be very well defined and judged to its true merits. Holt and Schoorl (1985:78) state:

> *"The almost complete acceptance of the systems approach by agricultural professions in the planning is a cause for real concern".*

Environmental Science yet being a scientific discipline under recent development, copes with all the theoretical questions concerned with system approaches. Fortunately, some attention has already been given to the development of the theoretical framework of Environmental Studies. An example is given by W.T. de Groot (1987:127). Field-operationalisation of environmental theories (which are rooted in various disciplines) appeared to be one of our main bottle-necks. Integration of emperical data with theories however, is the only way to reach the goal of Environmental Studies: to solve environmental problems. Before we discuss the analytical framework which was used in this study, we briefly go into some 'traps' of our holistic and interdisciplinairy approach.

3.2 THEORETICAL WARNINGS

Not only on the theoretical and the analytical level, but also on empirical and planning level we have to watch the traps of system approaches. R. Brouwer and K. Jansen (1988) survey the main critiques on system approaches in general (with emphasis on Farming Systems Research). We selected some of those critiques as we think that they may guide us in the theoretical approach of our study and in all further development of Environmental Studies.

1) the first comment concerns the low level of methodological development. Sometimes too much stress is laid on modelling. This has its own limitations:

> *"Dangers in modelling come from remoteness from target domains, the absorption of researchers' time in modelling and the omission of key factors from the models (Shand 1985: 93).*

2) A second comment concerns the extent into which attention is given to the interest of the farmers or local villagers.

3) Fresco(1984:257) stresses the danger of technological reductionism:

"The holistic and complex picture of the (farming) system during the diagnostic phase often is reduced to one or a few technical constraints, for which technological solutions are to be found."

4) A fourth criticism is given by non-radical political economists. Garrett (1986) points out that the stratification of cultivators (or managers of natural resources, the authors) in homogenous groups should not be made according to ecological or technological criteria, but according to the social-economic position

5) Becker (1986) and Oasa (1985) accuse the system theory thinkers of depolitization. By formulating a system approach that pretends to include all relevant factors and constraints political discussion about the desirability of certain solutions is excluded: science observes, models and optimizes; the task of politics is only to implement the scientifically proven solutions.

An overview of theoretical development of environmetal theories and their different approaches is given by Arts and Nypels(1986). Bandyophadyay (1987) shows how environmental problems as well as the solutions thereoff are imbedded in political forces.

To us it is a challenge to work from such a new man-nature-system approach. Criticism as stated above should help us to alleviate Environmental Studies as an instrument which has to be used to improve the position of those people who suffer from environmental problems. In the following we discuss the theoretical concepts we used.

3.3 MAN - NATURE- SYSTEM

The man-nature-system always consists of two components (H.A. Udo de Haes)
a) management: operation of nature by man.
b) the values and functions of ecosystems.

In our case studies we concentrate on the exploitation (man-induced) of local natural resources. Attention is given to the changing forms of exploitation and over- and underexploitation of water, land, living resources and their products.

The latter point b) needs some more specification:
In the Semi-Arid Tropics of South India, many ecosystems can be distinguished, all having specific (intrinsic) values and functions of their own or as a whole. We will refer to the following:

Important **conservation values** are e.g.:
- the rarity of species
- the diversity of species

Important **spontaneous functions** which we take into account are:
- the regulation of surface- and groundwaterflow from the catchment to the tanks and regulation of the groundwatersources.

- regulation of erosion and sedimentation to protect the drylands of the Semi-Arid Tropics and to prevent the tanks from siltatation. Grazing lands, forest and agricultural lands must be taken into consideration.

Besides spontaneous functions also **exploitation functions** can be distinguished, we give some examples:
- extensive forms of livestock management in the communal grazing lands.
- fishery in the tanks
- irrigated agriculture, both through surfacewater exploitation (tankwater) and groundwater exploitation (wells).
- dryland cultivation
- forest exploitation, fuelwood and fodder gathering

Finally, the **health function** most be taken into consideration:
- e.g. divers possibilities of resource exploitation may determine a adequat and varied diet. Exploitation of riverwater and groundwater resources are essential for good drinking water.
  (after: M.Marchand, F.H. Toornstra, 1986:9).

3.4 ENVIRONMENTAL PROBLEMS

Environmental problems can be defined as the distortion of the relationship between man and his surrounding natural resources. It is important that the degree of distortion will always depend on the perceptions that people, who have interest in natural resource management, have of values and functions. As interest differs because of indiscriminate access to, and unequal distribution of the products of natural resources, also perceptions differ. This makes an environmental problem a **social problem.** Both, causes and consequences must be regarded from social- political relations between individuals or groups.

Hence, when does the exploitation of local natural resources become an environmental problem? Two parameters must be studied:
1) the degree of (physical) degradation of local natural resources
2) the degree of (social) marginalisation of those people who are related to natural resource management.

A mean to qualify environmental problems is the degree of sustainability of local natural resources. The sustainability indicates to what level of resource exploitation reversibility (or renewal, or recharge) is not endangered. Furthermore it indicates the level of exploitation that does not induce un-acceptable changes of the total eco- and landusesystem[1]. Again, whether a change is accepted or not depends on the importance and interest of exploitation per individual or group.

The households and their members in a village community whose lives are intertwined with nature, belong to widely different categories- in terms of basic needs, power and consequently their access to local available natural resources. A radical change of the exploitation of local natural resources therefore affects the various sections of society to a diffe-

[1] In chapter 4 we describe which systemlevel is most preferable as unity of survey in both villages.

rent extent. It will change their margin of decision making, their means of satisfying their needs and risk-aversion.

The management of natural resources consists of the whole complex of exploitation activities, including decisionmaking and organisation of capital, labour and technologies in order to gain products of the natural resources through extraction and maintenance. As said before, the aim of exploitation may be various for different groups: fulfilment of basic needs or raising of a marketable surplus.

Per group the relation to local natural resource management exploitation is determined by:
- aim of exploitation, type of function (e.g. risk aversion vs. cash-crop production).
- scale, size per household, group etc. who has specific interest in natural resource management.
- type of access to natural resources and the type of land- and water ownership.
- social organisation and social relations within and between the different groups.
  (after Edquist and Edqvist, 1978[2])

Only after defining different groups or categories by these social determinants it is posible to study the relation between changes in local natural resource management and marginalisation of these categories.

Marginalisation indicated[3] the proces in which groups can not improve can not improve or even lose, both:
a) their (possibilities of) access to land, water and living resources
b) the disposal of technologies, capital, labour and equipments to gain products from local natural resources through extraction.

In chapter 4 we discuss the way we selected the various categories within the village. Here, we give some exampels how in a village different environmental relationships can be identified. Ofcourse such relationships are local specific, as will be shown in our case studies.

- Landless people who are totally dependent on the exploitation of communal forests for gathering of fuelwood and fruits.
- Small farmers whose main interests are the exploitation of communal drylands through the cultivation of traditional cereals.
- Wetland farmers, who use surface- and groundwater to fulfil their basic needs, but also try to grow cashcrops.
- Women, who gather a great diversity of fruits, fuelwood, herbs in order to guarantee a varied diet.

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[2]Originally Edquist and Edqvist use these factors as determinats of choices for technology of defined production-units.

[3]also individuals may be liable to marginalisation, but most of our study is focussed on categories, see chapter 4.

Also external groups may have an interest in the exploitation of natural resources. Some examples:
- Forest Department which shows little concern for long term management and seems to wish easy output through mono-culture plantations.
- Political parties, which emphasize the introduction of Basic Needs Programs to gain electoral support from the villagers.

3.5 CAUSES OF ENVIROMENTAL PROBLEMS

W.T. de Groot (1987: 128) mentions 4 types of possible causes to environmental problems:

1. Natural resource exploitation benefits individuals at the cost of communities. This is the so called tragedy of the commons (Hardin, 1977). Common Property Recources (CPRs) can be characterised by:
   - the fact that they are subject to individual use, but not to individual possession.
   - they have a number of users who have independent rights of use.
   - users constitute a collectivity and together have the right to exclude others who are not members of that collectivity (P. Blaikie & Brookfield, 1987: 186).

   Indian examples of the tragedy of the commons are widely elaborated by N.S. Jodha (1984 and 1987). In chapter 7 and 8 we present the management and degradation of communal grazing lands (Gomal lands) and communal tank- and groundwater.
2. Proposed and initiated solutions to environmental problems will benefit all categories involved, but these benefits are not felt as such on local, individual or village level. Some examples of social forestry programs, (which are mainly top-down planned) show that one can hardly motivate village participation (chapter 7).
3. Consiousness of environmental problems by a specific group is not translated into policy making and intervention on the same level of that group. For our case studies it is very important to study the attitudes of the several executive departments. The Irrigation Department meets severe pronblems of tanksiltation, but what do they do about it?
4. An important group of causes to environmental problems is taken together under the so called 'shift-mechanism'. We point out several of these mechanisms in our case studies in terms of:
   - present benefits dominate above future environmental problems.
   - environmental problems of one group are allocated to another group involved in natural resource exploitation.
   - individual benefits cause communal problems (tragedy of the commons).
   - the spatial dimension: exploitation of a specific natural resource causes unsustainable (over- and under)exploitation of other resources.

All these causes refer to the margin of decision within natural resource management. It is the aim of our study to emphasize the role of political and bureaucratic institutions. This, however, needs an (theoretical) integration of environmental studies with political sciences.

3.6 THE ROLE OF POLITICS AND PUBLIC ADMINISTRATION

Political Ecology

> "Sustainable development is the latest, though certainly not the last, development factor. Many among us will no doubt regard sustainable development as being the ultimante development issue, though it is likely to run its cycle as have the many developments factors 'basic needs', woven in development, integrated rural development, appropriate technology, farming systems research, that precededit" (Buttel & Sunderlin, 1988).[4]

It is our opinion that the introduction of any of these programs can only benefit those groups who really suffer from marginalisation when a prepatory analysis of the social- and political structures is made. Only in this way an assessment of distribution of benefits and social changes due to intervention can be made. This holds true for sociologists and political scientists as well as for environmental technicians, planners, policymakers, etc.

In their political ecology approach P. Blaikie & H. Brookfield (1987) make a plea for open-mindness on the part of social and political scientists in approaching land-degradation. The political economy concerns:

> "The effect on people as well as on their productive activities of ongoing changes within society at local and global level." (1987: 21).

This approach starts with the focus on the local manager and her/his relation with the natural resource. The next link concerns the interaction among landmanagers and groups within the larger society, which in turn influences the system of natural resource managements. And, finally, the relationschip to the state and global economy is made. We follow this chain (more or less) in our study.

> "There have been tremendous changes in the societies which nurtured and developed the systems of land mangagement (...) Market opportunities add to population pressures and surplus extraction as a strong additional force which puts pressure on resources. In many cases locally enforced authority has been broken down. The state is forced to step in to protect resources, not only from pressured small farmers and postoralists, but from contractors and opportunists farmers. The state is pulled into a vacuum created by pressures of the market, and the dissolution of informal traditional and local authority which the market and capitalist relations have helped to dissolve." (1987: 244).

Local institutions

Also our studies (chapters 7 and 8) clearly show that the question of adopting indigenous' resources management technologies (mainly through communities or village organisations) to the needs of 'modern society' is very complex, and should further be studied. We already stated (3.2 and 3.4) that environmental problems, firstly must be emphasized from the point of access to resources needed for natural resource management by

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[4] Buttel and Sunderlin made an assessment of the literature on sustainable development. They labelled four categories: 1) modes of extraction (ecocentric-ecological causality). 2) anthro-ecological (anthropocentric-ecological causality). 3) political economy of environment (anthropocentric-social causality) 4) critical political ecology (ecocentric-social causality).

those who manage: the farmers and the landless. A second part of the 'political ecology' approach brings us to the role of institutions. An example to be studied, is the Indian case of the **Mandal Panchayat**, a local self-governement body (see also 5).

State Institutions

Extrapolation of this example brings us to the role of formal motivation at the Regional and the State level. Where larger works for the exploitations and amelioration of natural resources are necessary, demanding inputs beyond those available to local councils, the role of the State and bureaucratic institutions become more important. This may be by direct intervention through execution of programs like tankconstruction, social forestry or terrassing, or indirect through legislation and control, decentralisation of powers and finances or price policies.

> "... but there is constant likelihood that it will be seen either as coercion or as something which governments should do and is not the business of, or even in the interests of, the farmers themselves".

4 METHODS AND TECHNIQUES

The study is carried out by an interdisciplinairy team of 3 students: a political scientist, a student in tropical land- and watermanagement and a biologist (2 male, 1 female).

To reach the objectives mentioned in chapter 2, a village study was regarded as the most appropriate approach. The villager is the direct beneficiary of the environment and can be looked upon as the (lowest level) manager of the environment.
The village can be considered as a unit for research as it can be distinguished spatially, socially and politically from other "living conditions". The working and living area is strictly bounded. The government mentiones the village as an important unit for administration and development programs.

Two villages were selected to study changes in natural resource management. Both villages are situated in the semi-arid region in the south east of Karnataka State. **Gatlagollahalli** in Tumkur district is a remote, indigenous village which is, to a large extent, self subsistent. The other village, **Kanithalli**, in Kolar district, is more outward looking in terms of access to markets, development programs and policymaking. The most important criteria for the selection of the villages were: the degree and diversity of environmental problems, its size (ca. 150 households), heterogeneous caste composition, cooperation of the villageheadman, diversified land use system with a tank and adjacent wetlands in a clearly distinguisable watershed (both villages with comparable Land Use Types) and practical logistic considerations: the necessity of a bus services (as close as possible to Bangalore) and lodging.

Data collection

Household selection

Data have been collected at household level as households are an important unit of production and reproduction.At village level the household is a clearly defineable unit of decisionmaking with regard to local natural resource management. Furthermore, environmental problems have their impact on the household budget.

Households were selected from a list compiled by the Village Accountants and during meetings with the village headmen, supplemented and cross-checked with information from other key-informants. Landholding was chosen as a parameter to distinguish the households reflecting the different access to natural resources like gardenlands, surface- and groundwater[1]. Landholding indicates social- and economical status.

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[1] access to water and the products from gardens is highly related to access to land (see also 8.4.2).

Subsequently the households were divided into the following landholding categories. This classification joins the offical government classification:

I	- landless labourers	
II	- marginal farmers	0 - 2.5 acres
III	- small farmers	2.5 - 5 acres
IV	- medium farmers	5 - 10 acres
V	- large farmers	more than 10 acres

From each category 4 households were selected at random, which made a total of 25 households (covering ca. 20% of the village population). This design was revised in Kanithalli as after the first rounds of interviews it appeared that landless were in reality marginal landowners. Because the landless were considered an important targetgroup more households were selected out of this category. As the interviews of the large farmers were very labourious in Kanithalli, timeshortage forced us to select only two households.
From each household mainly men were interviewed, as they are basically in charge of of land- and water management. Unfortunatly the accessability to women was less. Only one woman per category could be questionned about her activities in resouce exploitation.

Interviews

In the first orientating stage we used semi-structured questionaires. The questions were organised into two topics, respectively the personal situation and Land Use Type. These questions which provided qualitative data helped to define the questions which were to be covered in the second round. This in-depth survey permitted lengthy interviews on all basic needs, comparing various aspects of the situation now (1987), 5 years back (1982) and 10 years back (1977).
Ten separate interviews were held with selected well-water users to get inside into this specific problem.

Beside interviews with randomly selected households, several open interviews with key informants, such as the headman of the village, canalleaders, waterman, scheduled-cast leaders, members of the Mandal Panchayat, elderly people, secretary of the dairy board, teacher. Also people from other surrounding villages (for instance, users of the same tank or forest) and people met during field trips: villagers gathering fuelwood, woman grazing her cattle were interviewed. These turned out to be very important data, enabling better cross-checking of the collected data.

Furthermore interviews were held with government officials on village level (Village Accountant, members of the Mandal Panchayat, junior agricultural engineer), on taluk level (Range Forest Officer) and state level (like Social Forestry, Dryland Development Board) and with researchers.

Fieldtrips

Furthermore with information which was gathered during fieldtrips a map could be drawn of the spatial pattern of Land use Types in the total watershed. Of each land Use Type a global qualitative inventarization was made of the vegetation type, tree species and vegetation cover.

Secondary data

Other data of importance were maps and census materials of the villages, available at the office of the Village Accountant and at taluk headquarters.
Literature has been studied in the Netherlands and in India, including acts and other juridical material, administrative docouments and other government publications, etc.

The team

During the fieldwork period the research team lived in the villages. In this period Mr. Somashekara Reddy, visited the villages each 2-3 weeks. Three interpreters were hired, speaking Kannada and Telugu to enable each member of the team to conduct interviews individually. One of the interpreters was a woman, this in order to have access to female respondents.

Global timetable of the six months research:

February 15 - March 15	preparation of the fieldwork in Bangalore
March 15 - June 15	Fieldwork in Gatlagollahalli, Tumkur district (with the exception of a two weeks holiday period)
June 15 - July 1	Preparation of second fieldwork period
July 1 - August 1	Fieldwork in Kanithalli, Kolar district
August 1 - August 15	Literature collection in Bangalore and return visits to Gatlagollahalli

5 THE POLITICAL-ADMINISTRATIVE SETTING OF LOCAL NATURAL RESOURCE MANAGEMENT

5.1 INTRODUCTION

This section examines how the external administrative setting effects natural resource management at the village level. We will see how changes in relationships of authority and cooperation at the local level influence modes of resource exploitation. Does exploitation take place through individual or communal (or bureaucratic!) action. With traditional" or "modern" technology. Is the exploitation extensive or intensive. Are resources over- or underexploited?

5.2 RELATIONS OF AUTHORITY AND COOPERATION IN THE VILLAGE

In fact the villager should be considered as the main manager of the local natural environment. Next to physical conditions also the villager's social environment effects the quality of his natural resource-management: the villager is bound to a dominant social setting within and through which he has to operate. The village is composed of various groups, each with its own specific set of rights and duties. Traditionally also the use and maintenance of the forests, the irrigation system and other natural resources was regulated by such, well defined, rights and duties.
We will examine which rights and duties at present are exercised by studying the day-to-day practice of local natural resource management. Therefore we will especially concentrate on patterns of cooperation and on distribution-mechanisms. Questions have to be answered such as: which villagers have access to (the fruits of) certain natural resources and why?

Local authority- and powerrelations play a crucial role with regard to distribution and management of natural resources. Village leaders often maintained powerful positions of patronage and could, because of their status and function, control access to and the modes of exploitation of the natural resources. In the following chapters we will see which authority and power relations still have that influence. For that reason it is necessary to distinguish different roles of leaderschip.
First of all there are the traditional village leaders, often members of the most important families in the village. Most often they belonged to the old hereditary officialdom, e.g.: the Patel (village headman) and Shanbogue (village-secretary). The Patel usually belongs to the dominant cast in the village. The Shanbogue is per tradition a brahmin.
Though these hereditary offices have been abolished and replaced by appointed and elected functionaries (see 5.5), these ex-village officers still enjoy the prestige of their former positions. They have a thorough understanding of village affairs and local public administration and they know the channels to reach influential politicians and bureaucrats.
What one can call the "new men" are those villagers (sometimes of low caste origine) who improved their social and economic status and achieved a position of power through their contacts outside the village with party politicians, bureaucrats, bankofficers etc.
Then there are the villagers who got nominated to positions in the semi-government institutions at village level like the cooperative society and the dairy board. These villagers, such as the president of the dairy

board and the secretary of the cooperative society, perform honorary functions and enjoy the prestige and little salary related to their position.[1]
As latest we mention those villagers who got selected to the Mandal Panchayat (council of a group of villages).
There are reserved seats in this council for women and members of the sceduled castes[2] and tribes. During the elections for the Mandal Panchayat we can see in the villages what is probably the most manifest struggle for power and prestige.

5.3 MOBILISATION FOR NATURAL RESOURCE MANAGEMENT

From the point of view of natural resource management the traditional village leader still performs key-functions. As "ex-officio" leaders they maintain the contacts with the state bureaucracy. E.g. in case the tank-bund[3] needs to be repaired, most often the Shanbogue or Patel will approach the officers of the Public Works Department (P.W.D.) (see 8.6). Villagers often rely on such leaders in case initiatives have to be taken for communal activities: like the maintenance of irrigation canals, which demands the mobilisation of villagers to form a labour force. Apart from the Shanbogue and Patel, also other villagers are elected as irrigation leaders and are vested with powers to direct the farmers and take sanctions against defaulters. They will start deliberations with the farmers about such important matters as when to release water from the tank and whether water delivery will be according to a specific rotation scheme or not, etc. The irrigation leaders also instruct the Neerghanti (water-deliverer) (see 8.4.1).
Further examples are there of villagers who fulfill leading roles in communal activities which are more or less related to the management of the natural environment. E.g.: villagers who organize religious festivals (puja's) to call upon the gods for rain[4] and the tempelcommittee which maintains the trees on the tempelgrounds, etc.
(see Ch. 7).

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[1] Reading this we should keep in mind that persons who occupy certain formal positions within the village are not always the most influential members of the community.

[2] Haryans or "untouchables".

[3] Artificial dam, constructed to form a water reservoir (tank) for irrigation purposes.

[4] The fact that most villagers will attend these religious meetings emphasizes how the villager's social life is embedded in his relationship with nature!

5.4 THE EXTERNAL RELATIONS OF THE VILLAGE WITH POLITICS AND ADMINISTRATION

In this report a whole range of examples can be found of state initiated modes of exploitation which have changed or still are changing the natural surroundings of the (research) villages: the construction of a tank (irrigation reservoir), the clearfelling of the natural forests around the villages, etc.
More indirectly the state influences local natural resource management when its policies effect the social setting of the villager, in itself a force to change in the way the natural environment is exploited.
The external relations of the village with the modern state can be best understood in terms of a microsystem-macrosystem relationship. The micro-system, the village, embraces the indigenous influence spheres: the household, the castes, patron-client relationships etc. The macro-system begins where the influence of the modern state starts dominating. The formal political and bureaucratic institutions represent the modern state (C.M.L., 1985).
The intensity of this relationship can be expressed by the degree of "disclosure" of the village to state interference.
In this context it is useful to distinguish between place-based and non-place-based state intervention (Bryant and Whyte, 1982: 45). The latter includes, for example, the legislation on village administration or land distribution policies which lead to the privatisation of village forests and common grazing lands. Place-based interventions directly influence the villager's position. Such interventions include the so called "operational" (or "development-oriented") activities. They aim at providing services and inputs to the village: the promotion of certain cashcrops, the introduction of irrigation technology, etc.
The implementation of such state policies brings the villagers new sorts of relations with political, bureaucratic and commercial institutions beyond village-level (government departments, banks, etc).
Parallel to this the government is continously changing the political and administrative institutions which rule the villager's undertakings (and perceptions!) with regard to local natural resource-management. This dimension of state intervention is the subject of the next paragraph.

5.5 CHANGES IN THE VILLAGE ADMINISTRATION

The following sketch of the developments in village administration offers an illustration of the impact that state intervention has had on the relations of authority at the local level.
Indian villages have been called "Little Republics". For the great majority of the rural population the context of life has always been the "little society" of the village. Each member of the community had his own place. All castes had their appointed position in the rigid hierarchy. (For a definrtion of 'caste see note 22 on page 31). The village was controlled by an oligarchy of the casteleaders or council of elders, headed by the Patel (Tinker, 1963). Relationships were based upon inequality. Power was exercised on a patron dependent basis. (The socially or economically weaker sections sought the assistance and protection of the village elite, in return for their labor or its products).
This does not mean however that the village was fully selfsufficient. Each village was involved in a web of relationships with other villages and with a market town. This wider setting had its impact on the social and economic life in the village. Also the structure of power was not

confined within the village. The village was often linked to an administrative center. Nevertheless, the "state" remained an abstract power for most villages. The main political links between the village and the Government lay in the obligation to pay taxes and sometimes the obligation to contribute (forced) labour on the roads (See f.i. Frenken and van der Ent, 1981: 112).
The Patel and other village leaders were intermediairies involved in tax collection, the maintenance of law and order, and the representation of the interests of the village to outside powers.

When the British colonial rulers strenghtened their grip on the rural areas of the Deccan region they met village societies which all showed more or less the same internal authority-structure: the local village officialdom was composed of the Patel, the Shanbogue, the Tellaware (watchman), the Tothi (announcer & servant) and the Neeraganti.
To refine their machinery for the collection of revenue and local administration, the British rulers incorporated these traditional office-bearers into the lower cadre of their formal administrative network. A very succesfull manouvre, this enabled the British to penetrate and control the rural societies.[5]
After independence the State Government decided to abolish the system of hereditary village officials. It was thought that the proces of democratization and rural development would benefit from a system of nominated government officers and the introduction of elected village councils.
From 1959 the so called Village Accountant was to replace the Patel and Shanbogue. He was in charge of revenue collection and additional tasks for some five villages.
Also in 1959 the Village Group Panchayat was introduced. It formed the lowest body of the three-tiered Panchayati Raj system and covered eight villages. Its members were elected from among and by the inhabitants of these villages.
The "surrounding" government departments however, were not very much responding to the needs of this council and did not support or encourage the council's functioning. The Village Group Panchayat had but meagre funds and its activities were generally limited to the repairment of streetlights!

To reinvigorate village level democracy the then ruling Janata Government decided in 1986 to replace the Village Group Panchayat by the "Mandal Panchayat" (see 5.6.4). In the hope that it would counterbalance the rigidity of the state bureaucracy this council was given a larger budget and was entrusted with more powers and functions. To create wider possibilities for popular participation and attain greater efficiency the newly created Mandal Panchayats would cover 22 villages (instead of the 8 villages of the former Village group Panchayat).

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[5] The Mysore Revenue Manual, 1917 offers the most detailed information on the powers and duties of these village-offers.

5.6 THE WIDER POLITICAL ADMINISTRATIVE SETTING

5.6.1 "Four columns"

A great variety of political and bureaucratic institutions is operating at village-level. These institutions are part of the wider political or administrative system (regional-, State- or sometimes even Central level). We consider it useful to give a general view of the following political and bureaucratic institutions:

1. The segmented local and regional government; with offices on Divisional, District and sub-District (Taluk) level (see fig. 5.1).
2. The national and Statelevel departments which have their offices also at Taluk level.
3. Panchayat Raj - a segmented system of local selfgovernment with bodies of people - representatives; at Taluk and District level (respectively Mandal Panchayat and Zilla Parishad).
4. The political parties, active on different levels: central and State level politics is strongly related to political activities at local and regional level where the parties have their branches and politicians have their constituencies.

All the afore mentioned institutions have their representatives at village-level: the Revenue-officials like the Village Accountant, the extension workers, the villagers themselves which are elected to the Mandal Panchayat, and the members of the Legislative Assemblee (MLA) who visits the villages in his constituency.
Between these 4 "columns" (see fig. 5.2) official and non-official cross-cutting cleavages exist: e.g. prominent members of a political party have access to leading positions within the Panchayat Raj structure, etc. Often cooperation on a formal basis between members of different columns is part of their offical task-description, f.i.: the Dry Land Development Programme - initiated by the Central and State Government[6] - requires the collaboration of the officers from the technical departments and from the District and Taluk administration.

At the basis of these columns we find the non-formal factors, such as: caste, class and region. Complex powerrelations, based on caste or community membership or on purely interpersonal relations form a dimension which is sometimes part of, sometimes in conflict with the 4 "columns". Maybe the best example we can give is that "rudiments" of the officially abolished traditional authority structure within the villages still influences the functioning of the 4 "columns" at village-level and that membership of a certain caste is an important requisite if one competes for a political function.

5.6.2 The local and Regional Government

Throughout history administration in Karnataka region was structured in such a way that it could fulfill one of its main tasks: revenue collection. Also under British rule much effort was given to refine the revenue

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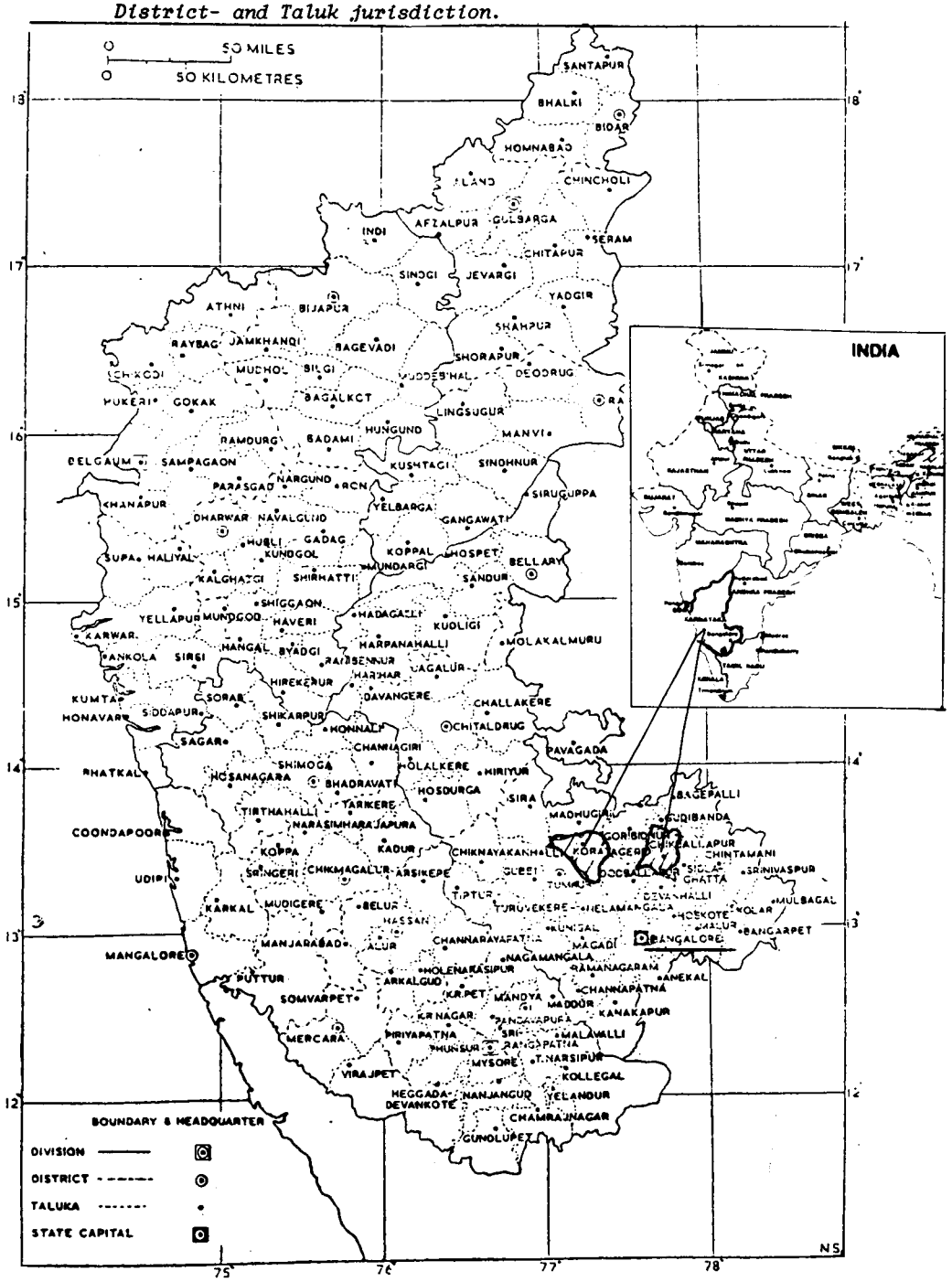
[6] The Republic of India is a federation composed of 23 states and 4 union territories. The federal (central) government resides in Delhi.

Fig. 5.1 The administative organisation of Karnataka State: Divisional-, District- and Taluk jurisdiction.

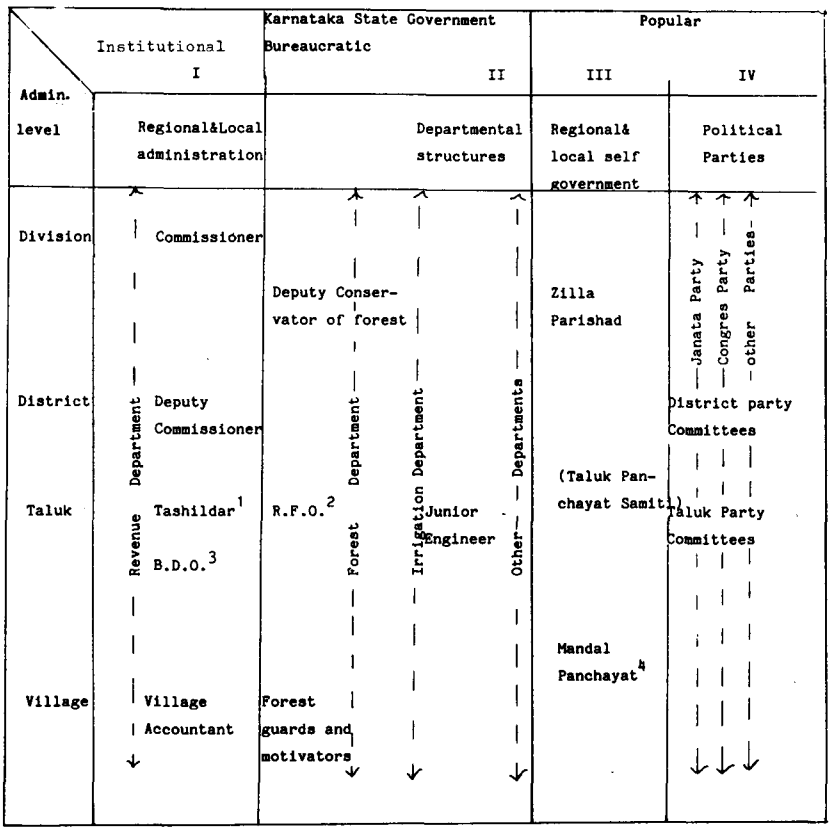


Gatlagollahalli is in Korategere Taluk. Korategere Taluk is in Tumkur District

Kanithalli is in Chicballapur Taluk. Chickballapur Taluk is in Kolar District

system. For this purpose extensive land surveys were conducted and thevarious indigenous forms of local government were merged into one uniform administrative system.
Land and Forest were the most important sources of revenue. With more than 70 pct. of the total population of the state deriving its livelyhood from agriculture and allied occupations, the Revenue Department came into contact with the largest number of citizens. Revenue officers were in charge of almost all items of work done on behalf of the governement in the "Districts" and "Taluks" (Rahaman Thulla 1970: 72). It was mainly during the British colonial period that more attention was given to the absorption of executive departments like the Irrigation Department and the Department of Agriculture into the administrative system. It is only after independence that "social welfare departments" were established.

Fig. 5.2 The vertically structured political or bureaucratic institutions (columns) and their linkage with the village society.



1 Coordinator and supervisor of other Departments and the Mandal Panchayat
2 Range Forest Officer
3 Block Development Officer
4 elected body for 22 villages

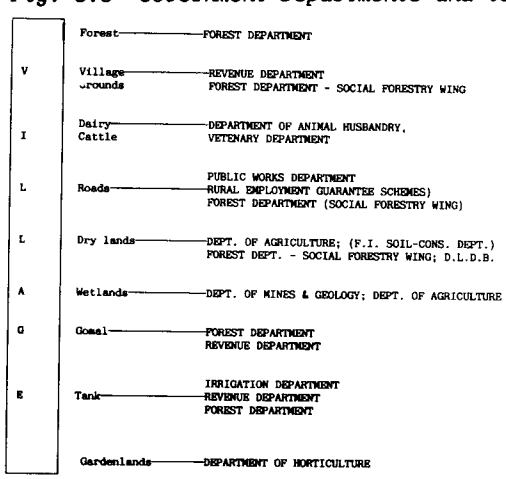
The organisational set-up

Todays Karnataka State[7] is spatially divided into 19 administrative Districts. Each District is further subdivided into sub-Districts or "Taluks" (see fig. 5.1).
The Tahsildar is the officer in charge of the Taluk, the lowest unit of local administration. Residing at the Taluk headquarters in the main town of his Taluk (which will approximately cover some 220 villages) he supervises his own (revenue) department. He also has the task to coordinate the other departments which operate at Taluk level and to supervise the functioning of the "Panchayat Raj" system of local self-government.
The so called "Block Development Officer" (B.D.O.) is responsible for the implementation of the development programmes in the Taluk.
The Village Accountant, a Revenue-officer, is charged with the registration and the collection of revenue for some five villages. He also deals with the villagers requests for government-subsidies, rationcards and such.
As a rule other departments will only send their officers with low frequency to a village: for extension activities or in a case of an emergency. There are exceptions, however, for example: the Soudi, an officer who is appointed on a full-time basis by the Department of Irrigation who performs the tasks of a Neeraganti, but then for a bureaucratically managed irrigationsystem (see 8.6.2).

5.6.3 The executive administration

The executive administration can be divided into technical and non-technical departments. Apart from the Revenue Department, which should be condidered as a non-technical department, mainly some technical departments play a role with regard to local natural resource management (see fig. 5.3).

Fig. 5.3 Government Departments and local natural resource management.



[7] The State of Karnataka was formed in 1956 during the reorganisation of the States in India which followed independence. It includes the former princely State of Mysore and several Kannada - speaking regions of Maharashtra, Hydarabad, the former Madras presidency and the State of Coorg.

The Irrigation Department and the Forest Department are most dominantly present in the natural surroundings of the villages.
Forests nor water resources follow the Taluk or District boundaries. Both departments have their own spatial set-up, which often deviates from that of the reginal or Taluk administration. However, their offices are mostly situated in the same towns as where the Taluk or District headquarters are located.
The organisational structure of all departments follows more or less the same blueprint, therefore we will only give the organisation-scheme of the social forestry wing of the Karnataka State Forest Department (see Annex: Organisation scheme of the Department of Social Forestry).

5.6.4 Local self-government

In 1959 the State Government introduced the Panchayat Raj system to attain democratic self-governement in the rural areas. This system (which again, has been recently reorganized) has three levels. At the bottom there is the Mandal Panchayat, a council for a cluster of ca. 22 villages. There above is the Taluk Panchayat Samiti.[8] At the district level there is the Zilla Parishad.

The Mandal Panchayat

As a rule for each 500 inhabitants a member is elected to the Mandal Panchayat council. The ca. 24 elected members of this body elect a chairman (Pradhan). The Mandal Panchayat keeps office in the headvillage, the biggest village in the Mandal (the area covering the ca. 22 villages, inhabited approximately by some 12.000 people).
A secretary (appointed by the Zilla Parishad) deals with the daily affairs.
The Mandal Panchayat has obligatory, discretionary and transferred functions.

- *Obligatory functions*: it is the duty of the Panchayat to make provisions within the villages regarding sanitation and health and to look after the construction and the maintainance of roads, drains, bunds, the regulation of grazing lands and so on. Further, the Panchayat is expected to improve agricultural production by planning, the provision of facilities (seedbanks, storage, etc.) and such. Another task is the promotion of the interest of the sceduled castes and sceduled tribes and backward classes.
- The discretionary functions embrace all measures which the Panchayat is free to take up in order to improve the welfare of the villages.
- Transferred functions are assigned by the Government (accompagnied by the necessary delegation of powers), e.g.: the management of forests, the cultivation of wasteland and the care for other common lands (see 7.)

[8] The Panchayat Samiti has not been established yet therefore we will not discuss this intermediate body.

The Zilla Parishad

The Zilla Parishad is composed of elected and nominated members[9], a president (Adhyaksha) is chosen from among the members. The functions of the Zilla Parishad can be summarized as follows. This body is charged with the formulation and execution of district plans. It has to initiate and coordinate the various development schemes.
The Zilla Parishad also has the superintendance over the functioning of the Mandal Panchayats.
It is important to notice that approximately 40 pct of the budget of the State Government is under the control of the Zilla Parishads. This means that the Mandal Panchayats as well as the state bureaucracies, like the Karanataka State Forest Depaertment, greatly depend on the Zilla Parishads for their funds.

The village level assemblee

In theory the "Grama Sabha", a village meeting, should congregate twice a year, under the supervision of the chairman of the Mandal Panchayat. The Grama Sabha is supposed to discuss and formulate proposals which can be placed before the Mandal Panchayat. Further the Grama Sabha is expected to prepare and promote development schemes within the village and to enable the implementation of the programmes of the Mandal Panchayat.[10]

5.6.5 The political parties

Though Karnataka has a multi party system, two parties dominate the political scene. From 1949[11] till 1983 the Congress party was able to obtain a majority in the Legislative Assemblee. With the election in 1983 the Janata party defeated the Congress party and succeeded in forming a government, supported by a strong majority in parliament.
There are three minor political parties who have representation in the Legislative Assemblee: two leftist parties (the Communist Party of India (CPI) and the Communist Party of Marxists (CPM)) and one Hindoe-fundamentalist party (the Bharatya Janatha Party (BJP).
With each election some politicians got elected on an "Independent" ticket.
Though the parties vigourously express their loyalty to Gandhism, socialism and democracy, neither Janata nor Congress possesses a specific ideology. In fact, both the Congress and Janata party are huge umbrella organisations, mass parties. As such they attract people from varying backgrounds, ideologies and interests.
Caste-interests, not class, create the most important struggles within the political arena's.

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[9] Seats are reserved for members of parliament (M.P.'s, i.e. representatives to the National Parliament), for MLA's, for members of the legislative Council (the upper chamber at state level) and for associated members (e.g.: the chairman of the District Cooperative Bank).

[10] The Karnataka Zilla Parishads, Taluk Panchayat Samithis, Mandal Panchayats and Nyaya Panchayats Act, 1983.

[11] The Maharaja of Mysore resigned as head of the government.

The parties have their refined hierarchic partystructure with branches at all levels and in all parts of Karnataka: there are District Party Committees, Taluk Party Committees. Even at village-level there are the party members which, not only during campaigns, but also in normal day-to-day life, manifestly represent their party-colours.
There are three major occasions during which the political parties are most active: the elections of the MP's who represent the citizens of Karnataka at the Union Parliament (the Lokh Dahl); the election of the MLA's, members who represent the people of their constituencies at the State Parliament; and the election of the members of the Panchayat Raj bodies. With the introduction of the Panchayat system (party) politics has increasingly penetrated rural village life.

5.7 THE GOVERNMENT AND ACCESS TO BASIC NEEDS

Since independence the emancipation of the poorer and weaker groups of rural Karnataka and the amelioration of their social and economic conditions have been major political issues. To guarantee the poor sections greater access to means of livelihood has been the objective of many political and administrative reforms in Karnataka. New departments have been created and extensive programmes have been formulated to reach these groups. Important to mention are the series of landreforms and the so called "Land to the Landless Schemes" (see Ch. 7).
Various departments have their projects under which the rural poor received inputs such as buffalows, ploughs and fertilizers. The introduction of Panchayat Raj was meant to encourage all villagers to participate in decisionmaking and activities which regard to their life circumstances.
It is in the line of this research that we delimit the use of the term basic needs to the primary products which the rural population extracts from its direct environment: food, water, fuel, fodder, etc. (see Ch. 3). (We will not give much attention to other needs such as education, sanitation and housing).
Now it is necessary to identify the political and administrative institutions which specifically aim at assisting the villagers in this type of basic needs satisfaction.
As we will see, most of the official programmes serve only a special narrow goal, without much concern for the creation of preservation of a stable natural resource-base for the benefit of sustainable basic needs satisfaction. In fact there is only a small number of departments which focus on local natural resource management.
The Community Forestry Program of the Forest Department[12] and the Watershed Preservation Schemes of the Dryland Development Board[13] are probably among the best examples of "basic-needs-oriented" government policies. However, these two programmes consider the well-being of the poor only as a much desired side-effect, though these people face most difficul-

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[12] This program is initiated to fulfill the local demand for fuel and fodder by raising trees on public or village grounds (see Ch. 7).

[13] This scheme, which aims at the development and preservation of the total watershed, approaches the idea of a broad integrated strategy. It embraces many components such as afforestation, soil conservation, soil-moister conservation and cropping techniques. Also the production of fuel and fodder is taken into consideration.

ties in fulfilling their basic-needs. In case of the Communal Forestry Program, the poor are not guarantied an exclusieve share over the produce as these local forest resources are meant to be communal (see Ch. 7). As regards the Watershed Development Programme: access to the natural resources is mainly restricted to the landholders who joined the scheme. Apart form incidental employment, the programme has not much to offer to the landless poor.[14]
It is for this reason that we will examine in the following chapters to what extent official undertakings in the field of natural resource management actually give attention to the position of the poor.

5.8 THE POLITICS OF DISTRIBUTION

5.8.1 The political culture in Karnataka

In order to understand the problem of the lowering quality of local natural resource management, the political culture in Karnataka has to be considered as one of the main explanatory variables. Politics shape the official policies, influences the way in which the state bureaucracy executes these policies and even interfers in relationships at the village-level. Therefore we think that also problems like the distortion of indigenous communal irrigation management, deforestation as well as the lack of proper land use planning and adequate investments in and execution of natural resource preservation and basic needs satisfaction can be partly attributed to it.

5.8.2 The role of caste-politics

When government in Karnataka after 1944 came to depend on elections, votes could be exchanged against patronage in a transactional system. Political mobilisation became a means to get into that system.(Hettne, 1978: 340). The political struggle in Karnataka around this mobilisation pattern has on to this day been dominated by the caste-structures (See also Epstein et al., 1985 and Hettne, 1978. It is for that reason that in our analysis of politics in Karnataka reference must be made to this caste-system. In Karnataka, a few castes predominate both numerically and in terms of economic status: the Vokkaliga caste and the Lingayat caste. Both castes, which form respectively ca. 14 pct. and 20 pct. of the population in Karnataka, are by tradition cultivators and landowners. The Brahmins, the members of the priestly caste, rank highest in the ritual caste hierarchy, but are numerically insignificant. Moreover, since the 1930-ths the Brahmnins increasingly moved to the cities (attracted by education and employment opportunities). And, as a result of recent landreforms against absentee landlords, many Brahmins have lost their landtitles.[15] Then there are the artisan castes and the servicing

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[14] The bund-raising scheme conducted by the Soil Conservation Department forms a rare exception. Under this scheme formerly landless people who were granted Government land under the "Land to the Landless Scheme" could apply for financial and technical assistance for bundconstruction in order to protect their, often marginal, lands against further erosion.

[15] Most Lingayats and Vokkaliga's, on the other hand, have remained in the rural areas. (See Epstein et al., 1985 and Thimmaiah, 19?).

castes. The latter are mostly landless and occupy a very low status. Their emancipation is the aim which politicians manifestly propagate.

The power and activity of caste in general increased as political power passed gradually from the rulers to the people[16], and politicians and political parties strove to attract support on the basis of caste identity.
The Indian constitution outlawed caste in general and granted protection to the ex-untouchables. The priviliges awarded to these groups encouraged also other underpriviliged castes to apply for special treatment. This resulted in the registration of "Backward Classes" by using caste as a criterium (Epstein et al., 1985: 18). This magic growth of caste polities had a detrimental effect on administrative efficiency and integrity (Hettne, 1978: 354), as politicians manipulated caste mobilisation for narrow goals.

Most autors who write about the politics of Karnataka state that the former Chief Minister Sevaraj Urs, whose Congress Government retained power from 1972 till 1980[17], changed the political climate in Karnataka and established the norm which still is in force, namely that it is the task of any elected government to work for the betterment of the living conditions of the poor (Panini and Srinivas, janurary 14th, 1984).
With that, another norm entered politics, namely that: "the best way to ensure political support is to do social work." (Epstein et al.; 1983: 63).
Politicians act as intermediairies between the administration and the villagers. They get information about the various services the government intends to offer to the rural areas and selectively pass the news on to those people who they consider as their clients. Politicians at the Taluk-level, especially those who belong to the ruling party, regulate the flow of funds from the State Government to the rural areas. They can block or divert the flow in directions entirely different from the ones intended.

5.8.3 The impact on natural resource management

We want to emphasize that these 'politics of distribution' also effect the quality of natural resource management in the rural areas.
For this statement we will give the following arguments.

Firstly, the political climate in Karnataka favours a sort of 'over-responsiveness' (Hettne, 1978: 10, 353) of politicians to the demands of their rank and file: their 'clients', fellow caste-members etc. This over-responsiveness tends to a wastage of public resources in order to accomodate their political pressure groups and other short-sighted interests. (Hettne, 1978: 353-354). F.i.: forests are among the first public resources which are sacrificed for this purpose. The clearfelling of natural forests, and the sharing out of government land, village grazing lands and such, should therefore be seen in this perspective.

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[16] This proces started under British rule, with the introduction of local self govemement.

[17] Exept for a brief interlude in 1977, when the Presidents rule was imposed on the State (Emergency period).

In this political system where power is based on, unstable, systems of patronage, the spending of 'development resources' by popularly elected ministers and other politicians leads, unavoidably to corruption. The above mentioned pattern of political mobilisation, which is characterized by opportunism and caste rivalry, is in fact a struggle for the spoils. This leads to conflicts within the administration, particularly between Brahmins and non-Brahmins and between Lingayats and Vokkaligas, which lowers the executive efficiency and integrety. (Hettne, 1978:353). This explains, foer example, that though not less than 20 pct. of the state budget is spent on irrigation, the irrigation potential in Karnataka is under-utilised. This is mainly due to the fact that the politics of distribution leads to bias the construction of expensive major irrigation systems, which adds to the welfare of the private contractors and the power and prestige of the politicians also are involved. Minor tank irrigation is for that reason heavily neglected. It is true that the need for politicians to oblige the maximum amount of organised interests leads to increasingly large ministeries (Hettne, 1978: 353) like the Public Works Department. However, little money and manpower is available for the maintenance of the smaller irrigationtanks and for support to organisations who manage these tanks on a communal basis. And then, this wastage of development sources means that little is left for the preservation of vulnerable ecosystems like forests: only 1 pct. of the total state budget is allocated to forestry (Seventh five-year plan (1985-1980))., though more than 20 pct. of the land surface is recorded as forest land!
The politics of distribution thus also works against some interest groups, such as the tribals, the landless and marginal farmers who depend on forests for their fuel and fodder and other means of livelyhood.
It is true enough that we said that politicians 'devote' themselves to the uplift of the poor sections, but then it must also be understood that this is, for most politicians, more a means for personal benefit (to gain votes to build a political base, to get access to administrative resource, etc.) than an end in itself.
For that reason, politicians prefer easy, showable successes, such as the granting of free housing to sceduled caste families, above long term investments which are necessary for reafforestation and the regeneration of the village grazing grounds. "Trees do not vote for you", as a Range Forest Officer commented. That the poor realise that they can get benefits from the government by virtue of their electoral weight is in itself a positive development. The intensive political rivalry in the political arena's at District and Taluk level makes it imperative for aspiring politicians to deliver at least some portion of the public goods to the poor.
It is unfortunate, however, that the poor are not offered the options which would really lead to their emancipation and economic security in the long run; and then we think in first instance about a guaranteed access to a sustainable natural resource base.
The caste system is among the causes which prevent the poor to organise themselves to ventilate their own preferences instead of being increasingly dependent upon the patronage and the favours handed out to them by politicians and bureaucrats.
In this context there is another problem, which will higlight in subsequent chapters, namely that the poor, and the same holds true for the other villagers, are loosing faith in their community's capacity to restore or preserve the surrounding natural environment.

With the latest statement we reach the second and at the same time the main subject of this section, viz: how the politics of distribution has its, maybe less visible but very direct, impact on natural resource management at the village-level. We allude to the fact that the above mentioned style of politics influences the social setting in the village and thereby changes the (indigenous) modes of cooperation and distribution with regard to the natural environment. In the chapters 7 and 8 these developments, such as the tendency of diminishing community participation in tank-irrigations management and forest-preservation, will be amply illustrated.
In Ch. 5.5 we already refered to the changing relations of authority and co-operation at the village-level which are due to external interference. We think, from our experience in the research villages, that we should pay attention to the specific way in which (some) villagers develop external contacts and how these contacts are maintained.
Further, we think that the impact of these external relations on the community participation in natural resource management is three-fold.
Firstly, there is a tendency that, often leading, villagers withdraw themselves from communal village affairs and focus their activities outside the vilage, as they expect that they can benefit more from their relations with politicians and bureaucrats. Through this, the village often lacks the mobilising role which these village leaders used to play in communal village undertakings.
Secondly, partly as a result of the above mentioned developments, also other villagers, both rich and poor, will send to bypass their traditional institutions (the old patrons, the caste committee, the traditional irrigation functionaries, etc.). They will seek the assistance of those villagers who have the external contacts. Through these intermediairies they hope to receive some of the services and material support which the government provides. In fact these intermediairies are what we in Ch.5.2 called the 'new men'. As a rule these vilagers, the new leaders, obtained a key position by moving up on the political ladder. They will shed some positions in favour of their trusted followers and consolidate their status by developing contacts at the top tevel, which they will use to check their followers from deviation. This can be tabulated as follows:

Fig. 5.8.3 Political patronage relations

	Positions		Range of contact	Range of power
Leaders	High	At Dist. & State level	Political Bureaucratic	Wide-External
Followers	Low	At Taluk & Mandal level	Limited	Limited - internal: caste-members; and other clients

Source: According to S.T. Somasekhare Reddy.[18]

[18] With courtesy to S.T. Somasekhare Reddy.

Each leader tries to manage that his followers approach only him for all the manipulations required at the various levels.[19]

In summary, there is a change in the nature of patron-client relationships. The arena for patronage has shifted from the village to the Taluk, where the patron acts as a mediator between the government and his clients. A villager, for instance a marginal farmer who wants to benefit from a government scheme, such as the granting of government land or a loan for an irrigation well, knows that the only way he can hope to cut through the cobweb of bureaucratic regulations and biases(!) is to get his local politician to act on his behalf. While the administrators at the Taluk-level are usually eager to accomodate the wishes expressed by local politicans (Epstein et al., 1985: 63-64).
Our third argument is that the penetration of village-life by party politics[20] often brings or increases disunity among the villagers. The villagers complained that inter-caste rivalry and personal conflicts get hardened as people take position under competing party-colours. How this effects natural resource management is, for instance, described in para. 9.4.2 where we deal in depth with the problem of conflicts over the maintenance of the irrigation-system, which lead to neglect and underexploitation.

Thus the arrival of new political leaders often clashes with the traditional system. It seems that the breakdown of community participation in natural resource management should partly be attributed to the increasingly 'outward-looking orientation' of villagers and the lack of adequate leadership. This proces has been accelerated by the abolishment of the traditional village officials, who often played an important role as catalysts in mobilising the villagers into communal activities. Some ex-village leaders still perform that function. Their authority and status, as far as these are based on their former position, is however rapidly eroding. The next generation of villagers will have to do without such leaders.
And then, we want to stress that the old system of authority relations in the village was not at all free from injustice and exploitation.[21] What

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[19] Idem

[20] There are three occasions during which the villagers are directly brought into contact with party politics: the election of the Members of Parliament (MPs), of the Members of the legislative Assemblee and the Mandal Panchayat elections (see 5.).

[21] In the Hindu society, the body takes a central place in traditional thinking. Bodies of persons and things are ranked according to their ritual purity or impurity. In this logic, it is the purest who must rule the less pure. (A distinction originally derived from that between life-giving and death-dealing).
This also applied to the practice of decision making. The individual was subordinated to the group, i.e. the joint family and casts. (Needs were seldom purely individual but societal). In general the lowest sections of the village had no voice in decisions of the village council.
The caste system requires that one treats other persons in accordance with their ritual superiority or inferiority. Morality did not require that one views all humans as equals, which also involved inequality of exchange. What the serving castes and the outcastes gave to the upper castes bore no proportion to what the former gave in return. Though, under conditions of inequality the caste system satisfied the

we do want to emphasize however, is that the village society is in a transitional phase. The collapse of the old structures has not yet been complemented by new structures of social responsibility and cooperation. This vacuum has given way to serious problems of mismanagement of natural resources.
This authority relation was/is indissolvably imbedded in the caste-system.

Björn Hettne states that the political system in Karnataka has frustrated the formulation of consistent development strategies and the evolution of adequate economic planning (Hettne, 1978: 378). We want to underline that the same accounts for land-use planning. The narrow and short-term time horizon of politics at the local and regional level as well as at the state level has led to an absence of what can be called physical ordening. With this we have mentioned our last argument. In the next paragraph we will deal with this problem of a lack of land use planning procedures.

5.9 ENVIRONMENTAL PLANNING IN KARNATAKA

5.9.1 Planning in general

Plans are formulated by the central government and by the state government.
First of all, planning has a role in the allocation of finances between the central government and the state governments. Further, the plans contain strict guidelines for the distribution of funds over the different sectors.
Secondly, planning is an official instrument to promote social and economic development.
In the 1970-s there has been a major shift in the planning strategies. It has been realised that the separation of the plan-objectives of economic growth and distributive justice was incompatible with the aim of fighting poverty. Statistics showed that only the rich had benefited from development. This implies the recognition of the planners that growth itself is not enough to abolish poverty and that special measures are required to ensure social justice. In the subsequent years, minimum needs programmes were made the centerpiece of the five-year plan (Epstein, T.S.; 1983: 21-22).
In Karnataka in 1978-'79 a second development in planning took place, when the state government decided to decentralise important planning tasks to the district level (Epstein, T.S.: 1983, 22-24). This redistribution led to the following demarcation of district-level planning schemes from state-level planning schemes:

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individual's need to belong somewhere (S. Kappen, 19?:15; see also de Tocqueville)).

State sector schemes	District sector schemes
Agricultural Production	Major and Medium Industries Investments in Corporate Bodies.
Soil Conservation, Forests	Generation and Distribution of Power.
Fisheries, Animal Husbandry Marketing	Ports and Inland Waterways State and National Highways
Minor Irrigation	Major and Medium Irrigation Projects.
Small Scale and Rural Industries	
Ayacut Development under Minor Irrigation Projects.	Ayacut Development under Major and Medium Projects.
Primary and Secondary Edudation Health.	Research and Training, Professional and Technical Educating, University Education.

Source: according to Epstein et al., 1983.

A third important development took place in Karnataka during the 1980-s when planning-powers were transferred to the Panchayat Raj institutions. (This transfer roces is not yet completed).
For instance, next to the District Planning committee and the district Development Council, now also the Zilla Parishad holds powers to decide about the outlay of District plans and the allocation of funds to the respective sector programmes.

5.9.2 Lack of spatial planning and environmental impact accessment procedures.

Nonwithstanding the developments in general social and economic planning, planning-procedures such as Physical Ordening and Environmental Impact Assessment have as yet, not recieved much attention. This is unfortunate. Such procedures would provide an important framework for the coordination of different departmental activities. With such framework the adverse effects of most interventions on the natural environment can be predicted, and, possibly, avoided.
In general we perceive a demand for planning procedures to mitigate short-term and unthoughtfull decisions by olitical or bureaucratic institutions.

In this context we want to mention the recently established Dry Land Development Board (DLDB). The DLDB puts the idea of spatial planning into practice by designing so called Watershed Development Schemes. Interdisciplinary teams, whose members are drawn form different departments execute these programs aiming at integrated land-use managements.

At last we name the central policies with regard to forestry and the rather promising role of the national Ministry of Environment and Forest.

The Indian Forest Conservation Act of 1980 states:

> "No forest will be clearfelled for non-forestry purposes without the prior approval of the central government."

The central Ministry of Environment and Forest created a network of "Regional Officers' to scrutinize state policies which aim at or sanction the conversion of forest to other landuse types.
In fact the Forest Conservation Act plus the executive procedures form a first step towards Environmental Impact Assessment.
At present, however, the network of regional offices of the Ministry of Environment is still to weak.It can not cope with the immense tasks with which it has been charged[22].

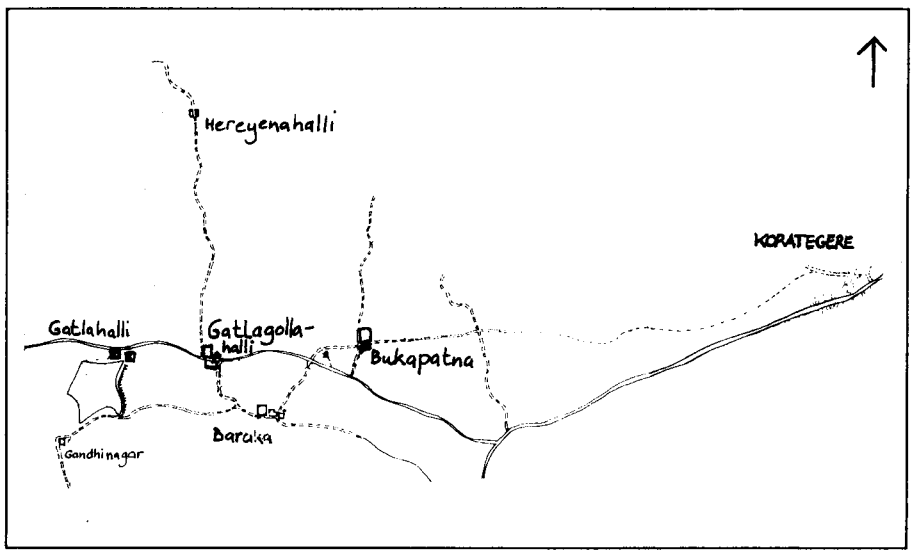
[22] See also: T. Matthew, former top civil servant in the Department of Environment; in : The State of the Indian Environment, 1985.

6 AN INTRODUCTION INTO THE VILLAGES

6.1 AN INTRODUCTION INTO GATLAGOLLAHALLI-VILLAGE

Gatlagollahalli is a small village situated in an undulating area (see Fig. 6.1). One reaches Gatlagollahalli by a metalled road. The road connects Korategere, the taluk headquarters, and Tumkur, the district capital, but forms only a minor connection. A private bus company maintains bus services - four times a day. Sporadically lorries pass by. The most important use made of the road, however, is by local villagers who just go by foot, bicycle, or bullock-cart.

Fig. 6.1 Map of Bukkapatna Mandal with Gatlagollahalli village
Scale 1 : 74 000



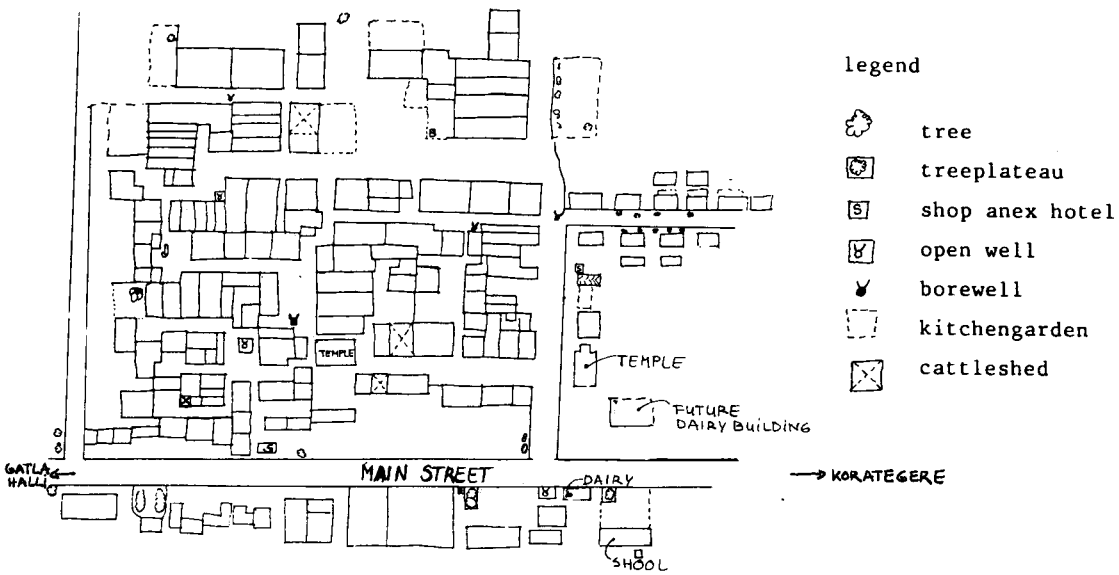
Source: Survey of India, village-maps, 1974 (sketch after original)

With regard to the foundation of the village the official records keep silent. Thus we can only rely on estimates of the older villagers. Roughly 200 years ago ancestors of the present Kavelagowda family (the family to which the last patel of Gatlagollahalli belongs) settled on the spot where at present Gatlagollahalli is located. According to K. at that time the area was covered with thick jungle. After the K. family had made a start with the clearance of the forest and had begun to cultivate, other families joined them and extended the settlement. (see appendix 1 Foundation of Gatlagollahalli).
Villagers estimate that in 1920 some 60 households (including joint families) lived in Gatlagollahalli. At present ca. 156 households, most nuclear families, constitute the village population.

6.1.1 Village lay-out

The closely spaced traditional dwellings are mud or stone walled with stone or thatched roofs, some with a courtyard. The cattlesheds are often part of the houses even in the modern buildings. The newly constructed concrete houses, painted in bright, pink or green have been set up along the south side of the road and north side of the village. On the eastside new box-like houses - socalled Janata houses- have been built with government assistance to house the poorer section of the population. (see fig. 6.2)

Fig. 6.2 Gatlagollahalli-village lay-out, 1987
Scale 1 : 4 000



Source: fieldwork, 1987

When we enter the village we see a small building with a signboard on top of the roof which mentions "Dairy Cooperative Society". The building, originally the community house (Chawadi), was constructed by the villagers themselves. Later the building was converted into an office for the Dairy Cooperative. It forms the collection- and registration center for the members, who live in Gatlagollahalli and the neighbouring two villages. Initiated by the Dairy Development Organization (a government-supported private company), the dairy cooperation started about ten years ago. A board of nine local members was installed. Monthly they settle the current affairs. The government appoints a secretary, who administers the daily registration and financial affairs of the board together with his

two helpers. Twice a day the 65 active members bring their milk (140 liters in summer, 260 liters a day in the rainy season). A truck from Tumkur Union takes the milk to Tumkur.
Opposite the dairy building stands the "panchayat house". This building was constructed with voluntary labour from the villagers, who received financial aid from the government. The building, which is not yet finished, is meant to serve as a new community house. It will also be used as a new housing for the dairy cooperative.

Next to the dairy building we find the school. In theory two teachers enable the ca. 300 village children to be educated up to 7th standard. At present, however, only one teacher is employed. He is paid by the Ministry of Education. Higher education can be attended in Bukapatna (at 1 km) - about 5-10 % of the Gatlagollahalli-children follow education up to 12th standard.

Gatlagollahalli has two temples. One is dedicated to the village goddess (Gangama), who is one of the 7 sisters-goddesses of special importance for this region. The other one is a Vishvakarma temple.
The temples are mainly used on special occasions like marriage or festivals. Daily pujas (worshipping) are performed inside the houses. No priests live in the village. Members of the Brahmin family do not perform priestly functions.

Three shops ("hotel") serve coffee and tea and sell some small daily used items like cigarettes, soap, pan, sweets or bisquits.

Since ten years drinking water is derived from an open well and 4 borewells. Because the water quality of the borewells is brackish the women often go to the open government well, 500 m outside Gatlagollahalli that supplies enough clean water even in summer.

Since 16 years (1971) electricity is supplied to the village[1].

An agricultural cooperative society sells subsidized products for ration card-holders (with a green card more subsidies: income less than 6000 Rs; red: income above 6000 Rs). The society is situated in Baraka, 1 km outside Gatlagollahalli and serves a total of 10 villages. The society buys these products from the farmers for fixed prices.

6.1.2 The population

The majority of the population of Gatlagollahalli is Hindu; only a few families are Muslim. The Hindu population is composed of different castes. Even though officially the castesystem has been abolished the caste wise division of society still has a major impact on social relations. First of all, the caste system corresponds roughly with a functional division of labour (although in recent decades most castes have also taken up several other occupations). Fig. 6.3 shows the castes repre-

[1] The reason for this comparatively early connection to the electricity network was that the Shanboque family successfully approached the authorities, having the arrangements for a marriage in mind for which they thought electricity facilities were required.

sented in Gatlagollahalli. The agriculturalist caste Vokkaligas is numerically dominant. Its members own most of the larger landholdings.
In Gatlagollahalli, only one family belongs to the Scheduled Castes, formerly called "untouchables".

Fig. 6.3 Number of households per caste in Gatlagollahalli

	number of households	%
Vokkaliga	71	46
Golla	34	22
Nayak	19	12
Lingayat	11	7
Muslim	6	3.5
Vishvakarma	4	3
Brahmin	3	2
Scheduled caste	1	0,5
T...(unknown)	1	0,5
Dhobi	1	0,5
unknown caste	4	3
total	155	100 %

source: Rao, Village Headman, 1987

Second, the caste system is a stratification of the society. Fig. 6.4 lists the castes in hierarchical order, according to their social position. In daily life, the caste system often serves to define social relationships. For example, patron-client relations are invariably based on the caste hierarchy.
Fig. 6.5 shows the distribution of landholdings over the Gatlagollahalli-population.

Fig. 6.4 List of castes in hierarchical order

Brahmin
Lingayat
Vokkaliga
Golla
Nayak
Vishvakarma
Dhobi
Scheduled castes

Source: Gazetteer, 1961

Fig. 6.5 Distribution of categories landholders over Gatlagollahalli.

Landholding category	number of households	percentage of total
landless	19	14 %
marginal	38	27
small	56	39
medium	26	18
large	4	2
Total	143	100

Source: Rao, village headman, 1987.

Sources of income

Although one could describe Gatlagollahalli as a self-sufficient village, households nowadays need cash income to supplement the agricultural production (crops, livestock, trees) to pay taxes, social obligations, school fees, health care, etc. Most of this cash income in generated by selling products. Milk is an important cash income for villagers from almost all social categories. Furthermore vegetables and fruits are sold: tamarind fruits and groundnuts from the drylands; coconut and arecanut from the gardenlands. Minor income sources are plates made from stitched muthuga leaves (Butea monosperma, Papilionaceae) and ropes made from sisal (Agave sisalana, Amaryllidaceae). Production and selling of silk cocoons has just started. Ragi and paddy are only sold in case there is a surplus.
Important off-farm activities are selling of fuelwood, stone quarrying and agricultural labour. Not only landless labourers, but also some small farmers depend for their main income on labour services to others. A few household-members have a job as teacher outside the village.

6.1.3 Governmental institutions in Gatlagollahalli

The village belongs to Bukkapatna Mandal Panchayat at half-an-hour walking distance. Only the Village Accountant keeps office in Bukkapatna, all other government officials who operate in the villages are allied to one of the deparments that have their local branche in Korategere. This Taluk headquarter is located at some 7 km from Gatlagollahalli (see fig. 1). Very few official extension activities are going on in Gatlagollahalli.

6.2 THE LAND USE SYSTEM OF GATLAGOLLAHALLI

6.2.1 Introduction

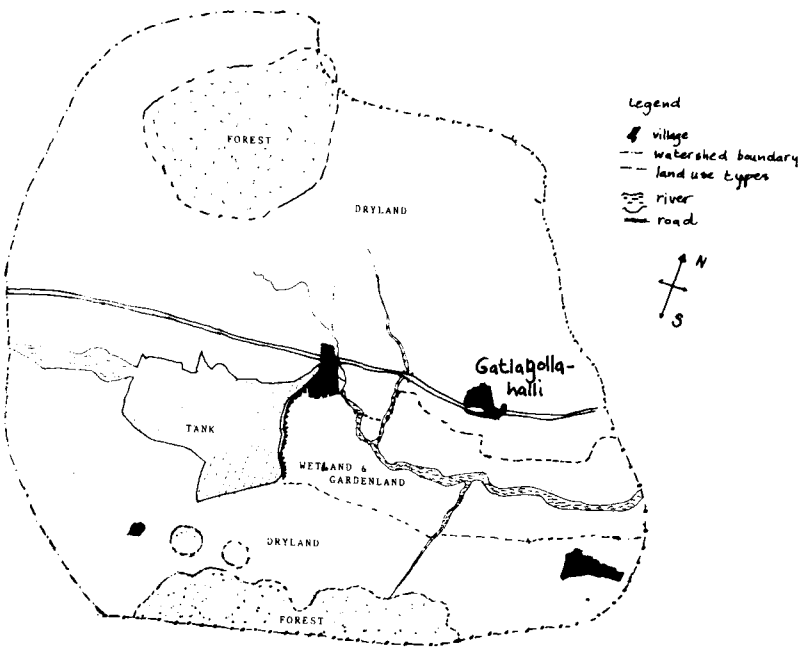
Agriculture in this region is still very much subsistence oriented. This means that by far the dominant portion of the production is intended for homeconsumption and that most of the labour is used in the village, i.e. not at wage-rates outside.
According to Ruthenberg (1980) the basic pattern of farming systems of the semi-arid region can be classified roughly as a "rainfed wet-rice"

system: the undulating area and the limited rainfall allow for a diversified use of the cultivatable lands; irrigated fields in the valley bottoms alternate with rainfed agriculture crops on the surrounding slopes.

6.2.2 Gatlagollahalli land use

Fig. 6.6 gives a geographical presentation of the land use types (definition see Ch. 2) prevalent in Gatlagollahalli.

Fig. 6.6 Land use in Gatlagollahalli watershed
Scale 1 : 24 000



Source: Fieldwork and village maps, Survey of India, 1968
(Gatlagollahalli, Gatlahalli, Baraka, Herejenahalli)

The following land use types can be distinguished (fig. 6.7 gives the size of the major land utilization types):

1. Villagegrounds with schoolyard, sacred treeplateau, village trees, primary and secondary roads, temple and "Kitchengardens" situated near the houses for the cultivation of vegetables and fruits

2. Agricultural fields[2]:
The **tank** irrigates the **wetland**, situated in the valleybottom and owned by three different villages: Gatlagollahalli, Baraka and Gatlahalli. Fingermillet and rice are the main crops.
The 69 **Wells** are a second irrigation source for the wetlands.
Gardenlands are situated on the borders of the wetlands. They are irrigated all year round often only with well water. Tankwater is supplemented if available. Cashcrops like vegetables, nuts, and fruits are grown.
On the **Drylands and privately owned wastelands**, situated on the slopes, rainfed crops are cultivated: annual crops (f.i. ragi, groundnuts, mixed crops) and perennial crops (f.i. tamarind).

3. Tank and river: the area of the tankbed, -bund, -foreshore, and riverbed, and nalas (small ancillary streams). The river streams from the tank to Korategere. The riverside is an important green belt.

4. Non-agricultural area
According to function, ownership, and management several units can be distinguished:
   A. Forest north and south of Gatlagollahalli, on and around hillocks on a distance of 3 - 5 miles, approximately 1 - 2 hours walk. Most of it is Forest Department land (i.e. Reserved Forest), Some remaining land is registered as village forest. The area supplies fuelwood, fodder for cattle etc.
   B. Burial grounds near the river bed
   C. Roads: one main road through Gatlagollahalli and some small cart roads. Products of trees planted along this road by the Forest Department are used by villagers.

(The former grazing land (gomal) of Gatlagollahalli has been completely converted into drylands).

Fig. 6.7 Acreage of major land use types of Gatlagollahalli.

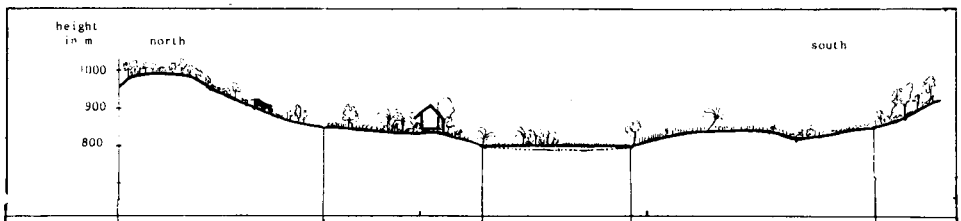
Major utilization types		in acres	in %
tank		70	
cultivated area:	irrigated by tank (total wetland 170 acres)	56	9
	drylands & gardenlands	303	45
area not available for cultivation		309	46
Total area of village		668	100 %

Source: Village Accountant Bukkapatna 1987

[2] Apart from villagers from Gatlagollahalli also inhabitants from other neighbouring villages and hamlets own land in the catchment.

Farming on this permanently cropped land is usually combined with cattle keeping. Livestock is kept not only to produce milk and meat, but also to provide traction power and manure.
Fig. 6.8 shows a cross-section of the land use system of the Gatlagollahalli-valley with land use characteristics.

Fig. 6.8 North-South cross-section of watershed with tank (100 m west of Gatlahalli), Scale 1 : 18 000



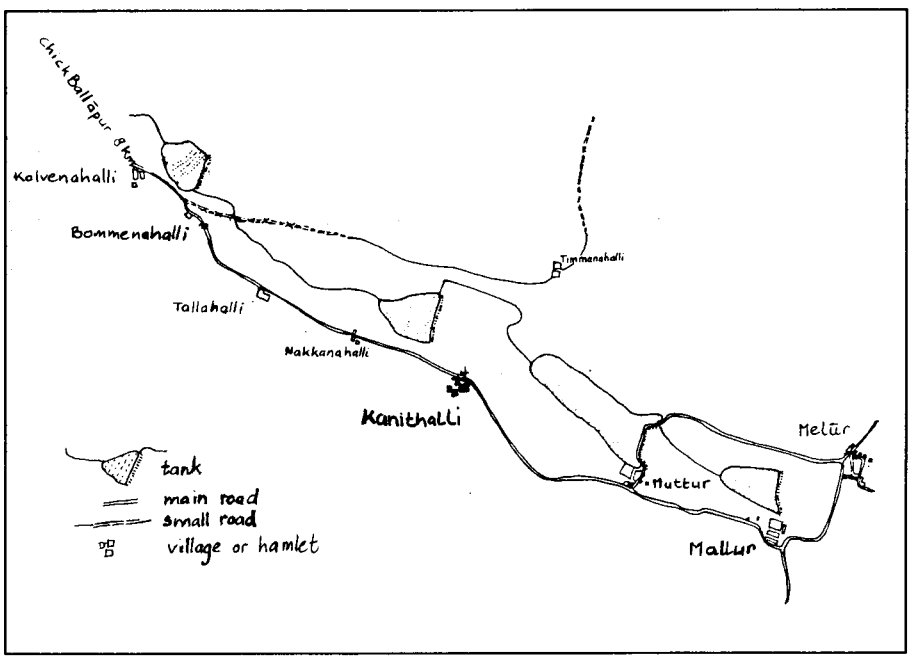
landuse	forest	road drylands kitchengardens	gardenlands tank and wetlands river	road drylands	forest
natural vegetation	scattered small trees and bushes	along border of field small trees	hardly any trees or or bushes in WL greenbelt along river	along border of field small trees	scattered small trees and bushes
soil	shallow loam to sandy loam	deep sandy loam	deep sandy loam to clay	deep sandy loam to shallow loam	shallow loam to sandy loam
geomorphology	granite				
main crops	eucalyptus	millet, mixed crops, groundnut in DL vegetables, fruits, herbs in KG	perennial crops, mulberry, vegetables in GL rice, millet in WL	millet, mixed crops, groundnuts in DL	eucalyptus

Source: fieldwork, 1987

6.3 INTRODUCTION INTO KANITHALLI-VILLAGE

Kanithalli is situated in Kolar district. It is a small village of about 140 households. The nearest bigger town is Chickballapur (taluk and district headquarters) from which a daily busservice to Mallur is maintained some 5 times a day, which passes by Kanithalli (fig. 6.9). More than Gatlagollahalli, Kanithalli is a transitvillage to the bigger and more important Mallur village.

Fig. 6.9 Map of Mallur Mandal with Kanithalli village
Scale 1: 46 000



Source: Survey of India, 1974 (sketch after original map)

6.3.1 Village lay-out.

The village layout looks very different from that of Gatlagollahalli. Although even here the older part is closely spaced, the newly constructed houses along the road dominate the view. There the richer farmers have settled. The most recently built house is owned by the son of the former headman. This house, with even a second floor, is also furnished with beds, chairs, tables and a television. Material wealth like this is not found in Gatlagollahalli.
With government aid thrice as much "Janata" houses as in Gatlagollahalli have been built for the large Scheduled castes community. The village looks more prosperous than Gatlagollahalli. The sight of a tractor is a striking example.

Since 1965 Kanithalli has a Dairy Cooperative Society which is housed in a garage-like building. Some 115 farmers from Kanithalli and Talahalli produce 500 l milk per day, or about 4.3 l/farmer, which is more than the average 2.1 to 4 liters in Gatlagollahalli. This difference can be partly explained by the presence of crossbreedcows in Kanithalli (see 7.24). A truck from Kolar Union brings the milk to Bangalore.
The Dairy Board tries to stimulate farmers to improve their milkproduction. Furthermore it gives educational support, helps farmers to get loans and supplies fodder concentrates. A few years back the board stimulated the cultivation of Napir roots to have one's own fodder.
From the profits derived from the selling of milk a small part goes to the members (only 4 %); the rest is put on a bank as fixed deposit for a new larger building.
The basic village provisions do not differ much from Gatlagollahalli, despite its prosperous outward appearance. F.i. Kanithalli has only one school up to 7th standard, 3 petty shops, which are larger than in Gatlagollahalli and sell more different products, and an agricultural coöperative society.
The two temples are separately used: the first one by the Scheduled Castes, and the second one by other castes.
Drinking water is derived from 4 borewells, of which the water quality is good. The open wells have dried up. Two ponds in the village provide drinking water for the cattle.

6.3.2 The population

Fig. 6.10 shows the castes represented in Kanithalli. The majority of the population belongs to the Scheduled castes and lives in the southern part of the village in the Janata houses.
Although the Vokkaligas are the second most important caste, they own most of the lands, whereas the Scheduled castes households are mostly landless.
Fig. 6.11 shows the distribution of landholdings over the Kanithalli-population. Category 'landless labourers' is larger than in Gatlagollahalli. Categories 'small ', 'medium' and 'large farmers' are much smaller.

Fig. 6.10 Number of households per caste in Kanithalli.

caste-name	number of households
Scheduled castes	80
Vokkaliga	50
Barbers	3
Blacksmith	3
Muslim	2
Brahm	1
Dhobi	1
Basketmaker	3
Total	143

source: Muniswanappa, former Vokkaliga leader, 1987

Fig. 6.11 Distribution of categories landholders over the Kanithalli-population.

landholding category	Estimates of the Shanbogue number of households	%age of total	Own estimates[3] number of households	%age of total
landless	6	6 %	56	39 %
marginal	33	35	33	24
small	33	35	33	24
medium	13	14	13	9
large	8	9	8	5
total	**93**	**99 %**	**143**	**101 %**

Source: Shanbogue of Kanithalli, 1987.

6.3.3 Sources of income

Most large and medium farmers only cultivate cash crops. Their cash income is generated by agricultural products like grapes, mulberry, and vegetables from irrigated fields, and by eucalyptus on drylands. Smaller farmers grow mulberry and sell silk cocoons.
Compared to Gatlagollahalli, milk is a more important cash income for small and bigger landowning villagers in Kanithalli.

6.3.4 Governmental institutions in Kanithalli

Kanithalli forms an administrative unit together with Talahalli. The village belongs to the Mallur Mandal Panchayat. The village accountant keeps office in Chickballapur, the taluk headquarters and the district headquarters, some 20 km from Kanithalli.
In the past and at present, Kanithalli has received more attention from government programs than Gatlagollahalli directed towards improving agricultural practices. Buildings like the silk cooperation society next to the dairy cooperative are a silent testimony to this government involvement, just like the government van visiting Kanithalli when the grapes are ripe to be harvested and taken to the cooperative society of Chickballapur[4].

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[3] According to our estimates the number of households is much higher than the Shanbogue figures. It is not a coincidence that the former Shanbogue, a brahman, is not familiar with the number of scheduled-caste households. A brahman never visits their houses, out of fear for caste-pollution.

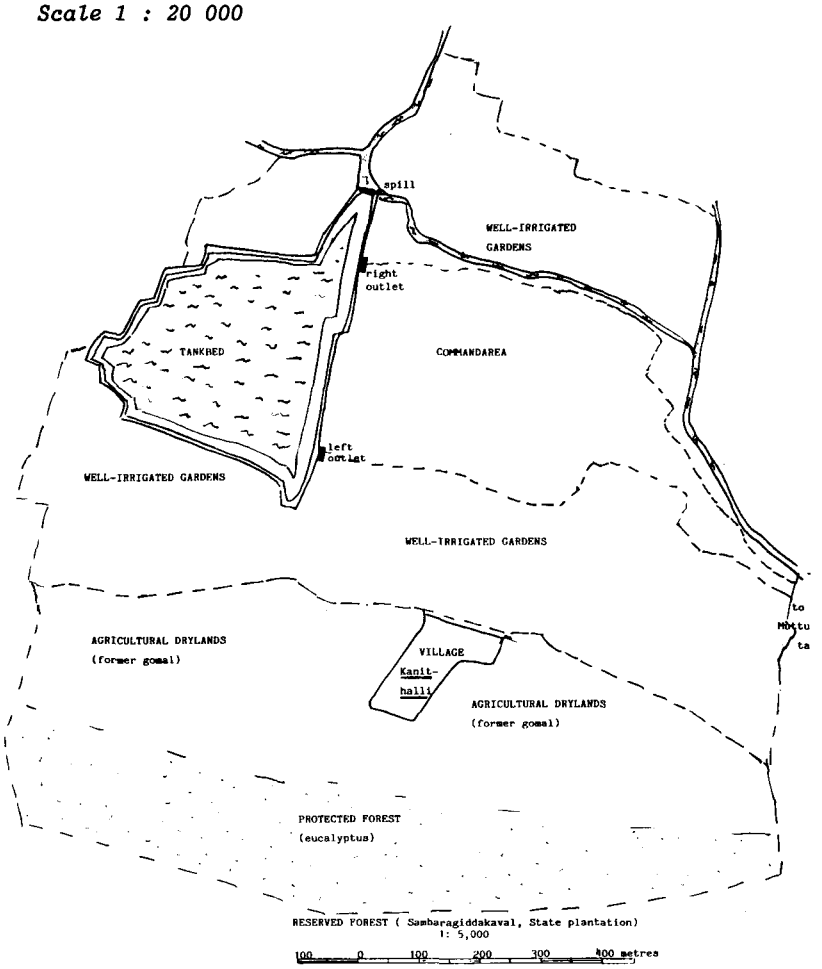
[4] Not all grapes are sold this way, middlemen also visit the village regularly. Advantage for the farmer is the credit he receives from the private company.

6.4 LAND USE SYSTEM

6.4.1 Kanithalli land use

The basic pattern of the farming system of Kanithalli resembles that of Gatlagollahalli. Like in Tumkur district, one can often see tanks in the landscape. The Kanithalli-tank is one of a series of tanks with its overflow emptying into another tank, as often is the case in this district.
Fig. 6.12 shows a map of the area with this serie of tanks and the basic land types: drylands, wetlands, gardenlands and forest/grazing land.

Fig. 6.12 Land use in Kanithalli watershed
Scale 1 : 20 000

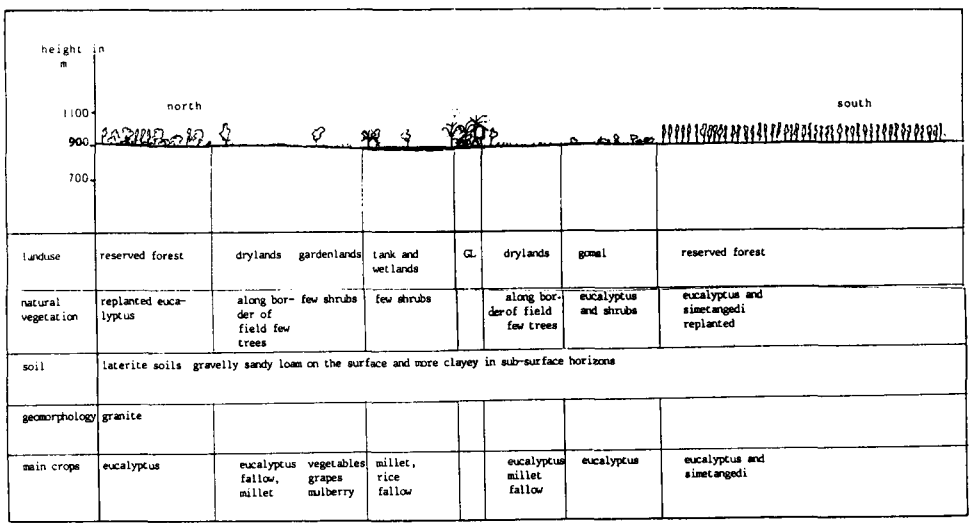


Source: Fieldwork and village maps, Survey of India, 1968
(Kanithalli, Timmanahalli)

Nevertheless, at closer inspection some major differences between farming in Kanithalli and in Gatlagollahalli appear. Entering Kolar district, one is struck by the sight of an area littered with small heaps of white uncovered sand (height ca. 5 metres) indicating the construction or deepening of a well. For 30 to 50 years now, well-water is the major source of irrigation, in contrast to the Gatlagollahalli-community with its almost exclusive reliance on tankwater. The (almost) all-year round availability of water, and Kanithalli's easy access to a market like Bangalore (only a two-hour drive from the village, compared to 5 hours for Gatlagollahalli), explain the differences in cropping pattern between the two villages to a great extent. Already from 1930's onwards, the village has been concentrated on growing cashcrops. At that time sugarcane and vegetables (mostly onions and beans) were grown mainly to satisfy the demand of the British military settlement in Bangalore. The demand on the Bangalore market had a substantial influence on this evolution in preferences for crops. Nowadays other vegetables, grapes and mulberry are favored crops for which all year round well irrigation is a necessary requisite.

Fig. 6.13 shows a cross section of the watershed where Kanithalli and some other villages are located.

Fig. 6.13 North-south cross section of watershed with tank with Kanithalli, Scale 1: 40 000



Source: Fieldwork and villagemaps, Survey of India, 1974

A short description follows of the main land use types:

1. **villagegrounds** - village with tree plateaus with large banyan and neem trees, four communally-owned tamarind trees, ponds, primary and secondary roads and a very limited number of **kitchengardens** situated near the houses.
2. **Agricultural fields**
   Wetlands (80 acres) are located in the bottom of the valley.
   The tank (75 acres), irrigating the wetlands, is one of a series of four tanks (see fig. 6.9). It has not been used for several years due to the severe drought. In earlier days the tank even contained fish. Most wetlands are kept fallow or only some 'dryland'-finger millet is sown.
   On the drylands and the adjacent privately owned wastelands situated on the slopes, rainfed agriculture is practiced. Here finger millet and mixed crops are grown; However, Eucalyptus-tree is becoming more important.
   The gardenlands are irrigated all year round by wells, providing enough water is available. Cash crops are grown, like grapes and mulberry. Of all the land types, the gardenlands receive most of the Kanithalli farmers' attention.
3. **Non-agricultural fields**
   On the southside of the road two different types of non-agricultural land use can be distinguished. First the grazing ground (gomal) which are also used for fuelwood collection, and adjacent the Protected forest owned by the Forestry Department consisting of planted Eucalyptus trees.
   The north side of the Kanithalli watershed also consists of drylands, with adjacent forest. The forest is too far-off to be of use for Kanithalli villagers. However, it occupies the slope, which is an important part of the catchment.
4. **Roads**: one main road leads through Kanithalli.

7. DEFORESTATION

7.1 INTRODUCTION

Functions of forests

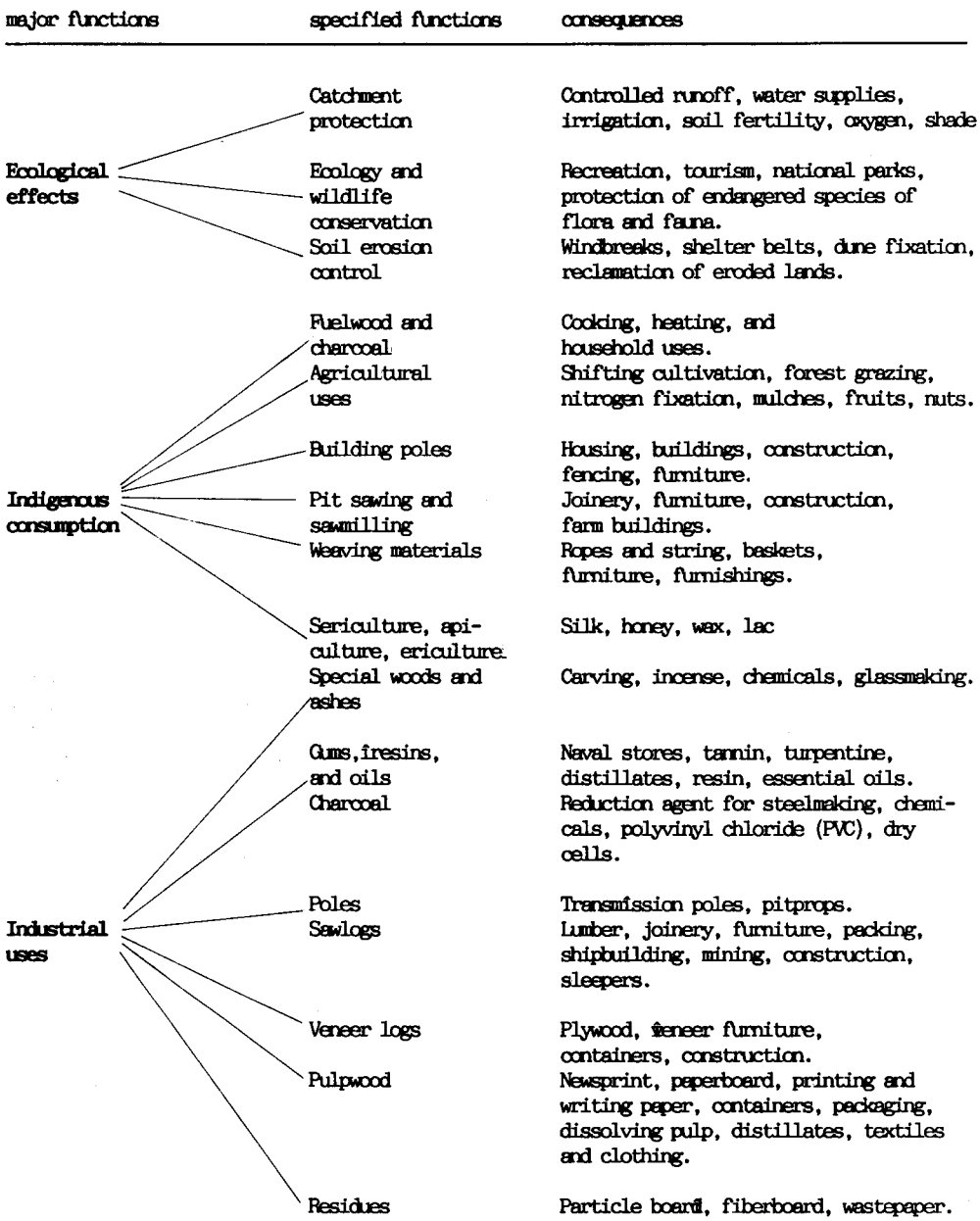
Forests fulfil several functions. Urban and rural people need firewood and fodder for their cattle from the forest. People also depend on forests for minor products like bamboo and medicinal herbs. Governments and industries need products like pulpwood for paper mills, timber for railways and construction works, softwood for the plywood factories etc. In fig. 7.1 an overview is given of possible functions of forests as defined by the Worldbank. The functions of forests are devided into three major categories: ecological functions and production functions for local and industrial use.

Deforestation

Forests in the areas studied have undergone immense changes. We speak of **deforestation problems** if forests diminish due to an increasing demand or due to the extension of the agricultural area at the expense of the forest. We regard this reduction of forest(area) as a problem if it results at the same time in a negative effect on the ecological regulation mechanisms or in a shortage of forestproducts, or in a lowering of the values of nature.
According to Hussain (1987) a village in South India needs about a quarter of its lands to be forest area.
Forests are not the only source of tree products. Also trees in e.g. the agricultural fields serve as a source of basic needs for the rural population. The level of pressure on each source is highly dependent on the possibilities for needs-satisfaction from other sources. Therefore the problem of deforestation as described above should be understood in the context of (changes in) total land use management.

The extend to which deforestation is a problem in the drought prone areas of Karnataka will be illustrated with the two case studies. Each case-study will describe problems with regard to the satisfaction of several basic needs from the environment (fuel 7.4, fodder 7.5, timber 7.6, green manure 7.7, minor products 7.9). Furthermore in each paragraph the consequences of scarce resources for the distinguished categories will be discussed in terms of familybudget, health, workload and subsistence security. In 7.10 we will concentrate on causes of deforestation.

Fig. 7.1 General functions of forests



Source: Forestry sector policies, Worldbank, 1978.

Fig. 7.2 Land use types and their products filled in for Gatlagollahalli-villagers

	staple food	vege-table	fruit	fuel	green manure	fodder/ grass	timber products[1]	minor
Drylands	*		*	*	*	*	*	*
wetlands	*	*	*	(*)	*	*		*
gardenlands	(*)	*	*	*		*	*	*
kitchengarden	(*)	*	*	(*)	*	*		*
forest			*	*	*	*	*	*
grazingland				*	*	*	*	
tank	*3					*3	*	
roadside			*	*	*	*	*	*
riverside			*	*	*	*	*	*

note: 1. minor products are (medicinal) herbs, roots, decorating leaves, bamboo, flowers, etc.
2. (*) = of less importance
3. During the dry season the tank is empty and used for cultivation and grazing

Source: fieldwork, 1987

Other problems related to deforestation

Beside providing a sustainable source of several products (basic needs), forest play a significant role in preventing soil erosion, conserving the underground and surface water sources. Trees conserve moisture by reducing the evaporation of streams, tankwater, and small ponds. And trees are the habitats for a large number of insectivourous birds, which pray on insects harmful to agricultural crops.
Furthermore it is thought that the number of rats that destroy a large amount of foodgrams has increased considerably as a result of the reduction in the number of snakes. That rural people give importance to snakes can be deduced from the fact they preserve snakeholes. Snakeholes are considered holy and "pujas" (holy ceremonies) are performed at the entrance of the holes during weddings.

Forests, but even more trees in general, improve the living environment. They provide shade for the cattle. Along the road they render travelling more comfortable. On the other hand shade is one of the main reasons for farmers to cut a tree or not to replant one. Many farmers apparently prefer the short-term benefit of increased crop yield over the long-term profitability of a tree.

Exactly to what extent a decline in vegetation cover influences the precipitation pattern is not clear. A study conducted in the Western Ghats (mountain range in the west of India) showed that reduction of forest cover seems to effect the precipitation pattern showing a reduction of rainfall-rainy days (Meyer-Homji, 1980). However, the relationship is not one-way but two-way: a change in precipitation pattern also influences the total vegetation.

Obviously the relation between vegetation cover and precipitation for the two casestudies cannot be determined, as the loss of vegetation cover is part of the deforestation of the whole region.

7.2 GATLAGOLLAHALLI'S TREE WEALTH

In Chapter 6.2 a short introduction has been given about Gatlagollahalli-village in Tumkur district. The different land use types have been indicated. This paragraph mentions the importance of taking into account the total land use system if one wants to understand the problem of resource depletion. Each source supplies several products. Fig. 7.2. illustrates that several different products can be derived from the major sources in Gatlagollahalli. In Appendix 2 a list is given of the dominant tree- and shrub species that are found in Gatlagollahalli. Indicated is that some species have specific functions whereas others are multipurpose. In the next chapters the important species will be described in detail. The appendix serves as an overview.

To answer the question whether the resources of Gatlagollahalli can still fulfil their functions, one needs to know, among other things, to what extend the vegetation has undergone major changes. Through interviews with villagers and fieldtrips the present condition of the sources could be compared with the situation some 20 years ago.
Furthermore not only this question is of importance, but also the question whether (groups of) villagers have access to these sources.

In the next paragraph we will indicate for each land use type the present condition and the accessibility, after which an indication will be given of the changes.

7.2.1 Trees and shrubs in the non-agricultural area

Forest - north and south of Gatlagollahalli

In the northern part of the forest on a distance of 3 miles from the village, the vegetation cover is merely restricted to the slopes and feet of the hillock whereas the hill-top, which is subjected to strong winds and erosion, remains barren with an exception of a few shrubs and grasses (fig. 6.6). Of all the surrounding forests this one is closest by and therefore mostly used by Gatlagollahalli villagers.
It is common in this part of the state that the hillocks, which all belong to a group of hills, have steep barren rocky slopes (Rao, 1964).
The forest on the northside of the hillock is owned by the Forest Department. It is a "Reserved Forest[1]" which indicates that all activities are prohibited accept for people who have a written permission.

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[1]. As constituted by the 1927 Forestry Act, three types of forest can be distinguished:
- Reserved Forest: all activities are prohibited accept for those for which written permission is given
- Protected Forest: less stringent restrictions on local use, the authorities make lists of acts permitted
- Village Forest: forest used and maintained by the villagers.

All natural vegetation belongs to the dry-decidious type[2]. The condition differs with the external pressures. The Reserved Forest consists of a few rows of recently planted eucalyptus and jali-trees[3] (Acacia nilotica) of only maximally 3 meters high, a spontaneous shrub-vegetation and without an underlayer of perennial herbaceous species. A spontanic uneconomic shrub-vegetation, with beli-shrub (Lantana camara) is becoming dominant in this 'forest' areas. The vegetation cover in the dry season is near the hillock on an average about 5-10%.
The soil is heavily eroded. Sometimes gullies exist of more than ten meters wide.
The village-owned part of the forest is situated on the rest of the hillock. The quality is better especially on the higher parts: the thorny shrubs and steep slopes do not allow an easy access. Nevertheless large parts are completely rocky without cover. The vegetation cover of the northern side is higher - on an average 30 % - probably due to the long walking distance. The regeneration of species is only quite good in this part. On the foot of the hillock mostly shrubs like beli (Lantana camara), sige (Acacia concinna) and thorny shrubs can be seen. Although no hardwood species are available anymore, different soft-wood species can be noted. The underlayer consists of grasses[4].

Forest in south-west area

Although not many villagers of Gatlagollahalli make use of the southern part of the forest, we will pay attention to this part of the watershed as the slopes in this area are very vulnerable to erosion. This affects the agricultural practices of the Gatlagollahalli-villagers.
Clear rocks are alternated by flat stone massives. In some places the topsoil has been completely washed away, exposing the rocky underground. In between the big rocks small bushes come up. At intervals on less steep parts, trees grow. They are never more than two meters high. The diversity of tree species is less than on the northern hillock. The vegetation cover is 20% at the maximum. It is not surprising that an important activity on this hillock is stone quarrying.

Deforestation

The two forest units distinguished above have undergone considerable changes in the past decennia.
Kavelagowda, the oldest villager of Gatlagollahalli, described us the area some fourty years ago. Through his eyes we could get an impression of some of the striking changes e.g. in diversity or accesibility. In earlier times more animal and plant- species could be distinguished, e.g.

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[2]. The results are based on a global inventarization of the vegetation of the area. Common species have been noted.

[3] If possible English names of species are given. However of some of the indigenous trees only local names are known. Therefor botanical names are given in between brackets.

[4]. The research was conducted in the summer period (March - June 1987). An estimation of the annual species could be made through oral information.

deer or hardwood species. Furthermore the vegetation cover declined. But not only changes took place in the quality of the forest, also the total forest area declined. Figures obtained from the Revenue Department illustrate his story (see fig. 7.3).

Fig. 7.3 Acreage of land use types in Gatlagollahalli in 1904, 1942, 1966, 1980, and in 1985.

	1904	1942	1966	1980	1985
village	6.15				
roads	2.09				
forest		-			
land put to agri-cultural use		12.28			
barren and uncultivatable waste	71.10	75.10			
pastures & grazing lands	177.04	181.40			
cultivatable waste	30.39	30.32			
tree groves		-			
Subtotal	282.37	299.10			
agricultural use ?	380.20	? 369.07	368.39	372.31	376.16
total land	668.17	668.17	668.17		

note: Although not complete the figures give an indication of the acreage
source: Dept. of Land Records and Settlement.

Forty years ago the village was surrounded by forest. Only a small strip of village land was used for cultivation. One-third of this area was in use as grazing land (gomal).

From 1936 onwards the forest was demarcated in "coups" (tracts of forest). Private contractors got these coups on lease for commercial purposes. After felling the trees the wood was converted into charcoal, a substitute for coal and petrol to fulfil the fueldemand of industry and transport. The major exploitation took place during the second world war. No reafforestation was taken up. With one exception, the Forestry department started Eucalyptus plantation on the southern ridges. The government's main rationale for the coupsystem was to increase the revenues and to satisfy the industrial demands. Villagers were excluded from the profits of forest exploitation. They only profitted by working as labourers for the contractors. In 1952 the coupsystem was abolished, probably as a result of the total depletion of exploitable forest. Short after independence, when the villagers access to the forest was under less tight control of the authorities, (as there was a sort of power-vacuum following the transfer of souvereignity) much of the remaining forest was cut by the villagers themselves. Due to the growth of the village population total demand for forest products rose. Then, under "land to the landless" schemes in the 1970-s people were granted governmentland for private cultivation.

The vanished gomal

The gomal (grazing land) was situated north-east of the Northern Hillock. In 1904 it occupied one-third of the village area. All villagers used the gomal for cattle-grazing. The use of the gomal was more or less controlled by the Patel and the Shanbogue. The Shanbogue collected the obliged annual payment (regardless the number of cattle) of 25 paisa (4 anna) from each household.
According to older villagers, at that time the vegetation of the gomal consisted of good grasses and many different tree species. Even ponds existed in this area in the past, supplying drinking water for cattle.
At the moment this gomal land is partly converted into eucalyptus plantation of the Forestry Department (20%), and partly formally granted or encroached by villagers.

Thus former forestland and the greater part of the communal grazing land were distributed. Some of these lands were already encroached due to landhunger: the result of landlessness and the cutting up of landholdings which accompagnied population growth.
Even now, more village land is brought under cultivation, legal or illegal, though not many possibilities for further encroachment exist. The sudden steepness of the hillocks and their rocky surface prevents expansion of the cultivated area.

Tree-wealth of the Wastelands

Roughly estimated, the Revenue Department considers about 10% of the village area as wasteland. The Forestry Department defines wastelands as barren, uncultivable land. If situated in the vicinity of, or on an agricultural plot, wasteland is privately owned. In that case its products are for the farmer even though no land tax has to be paid.
Actually, because of their degraded state, many of the areas described in the paragraphs above could also be defined as "wastelands".
Rocks are visible at the surface of probably 50% of the wastelands, offering an easy opportunity for further soil runoff.
The natural vegetation of the wastelands resembles the vegetation in the northern and southern forest regions. Honge (Pongamia glabra) and jali (Acacia nilotica) are often-seen species. Also species like tuggli (Albizzia amara) used for animal fodder and muthuga (Buthea monosperma) are available. The leaves of muthuga are stitched together by women to form plates which are sold on the nearby market during the dry season when there is no agricultural work.
Besides profiting from the natural vegetation and its products, farmers sometimes actually (re-)plant useful trees on the wastelands like tamarind, as this species is very drought-resistance and is not hampered in its growth by the rock formation just underneath the topsoil, thanks to its superficial root system.

Fig. 7.4 Changes in the forest quality in Gatlagollahalli between 1947 and 1987

	1947	1987
accessibility	Thick forest, closer by. Use of borders of forestmore than 10 miles (Siddhera batta), The inner parts remained untouched	Distance to a thick(er) forest Demands are met by the degraded 'jungle', to which distance also increases. To obtain good quality wood women and children have to walk further. In the Northern forest, even green wood is collected. Walking distance to necessary resources has doubled.
diversity of flora	More hardwood species like sandalwood (illegally cut by smugglers and sold on Bangalore markets).	Less hardwood species, almost only softwood species. Excessive thorny species.
condition of vegetation	Forest up to 10-15 m high. Three vegetation layers with an almost even destribution of representatives in the layers	Maximum height 5 meters. Height of trees reduced due to lopping. Rejuvination of vination of forest almost reduced to a few thorny shrubs and some trees of which the seedlings are not eaten by cattle.
cover	Decline in cover.	
fauna	Hunting in Gatlagollahalli: forest-pigs, deer, tiger, bear.	Hunting only in Siddherabatta: forest-pigs.
management of hillock forest	Forest guards were paid by Forestry Dept to protect sandalwood trees and other hardwood species, but were bribed by smugglers.	An increasing pressure on the hillock forest due to higher population density and growing industrial demands decreased the products available. Forestry Dept. only tried to plant a few eucalyptus trees.

Source: fieldwork, 1987

Trees along the roadside and on the villagegrounds

Approaching the village can be done in the luxury shade of Pongamia trees[5] along the road sides. Also ornamental trees (often "red flowers") are planted to provide shade for travellers.
Roadsides are often considered as an important source of biomass to satisfy basic needs. Villagers generally prefer to gather their fuelwood,

[5] Often leaves and flowers from Pongamia glabra, which to our experience could also be called 'air-conditioning-tree'.

fodder, green manure and other natural products from vegetation nearest to their farms and village. Farmers with adjacent lands are considered the rightful owners of the products of roadside trees. However they are not always on their properties to prevent theft.
In Gatlagollahalli itself, there are two treeplatforms - one in the schoolyard and another near the main entrance to the village (see village map) - with two old trees, Banyan (Ficus religiosa) and Neem (Azadirachta indica). Because these are holy trees their products are never used for household purposes.
The information gathered about the earlier tree wealth was not very consistent. Probably the number of trees along the road diminished during the last 20 years. Not many trees have been planted, but Pongamia spreads very easily.

Vegetation in and around the tank

Along the tankbund only small bushes (namely bandare (Dodonea viscosa), kare (Canthium parviflorum)) are planted. Trees are removed, as their roots penetrate the main bund and cause leakages.
During the rainy season, the tankbed stores water for approximatly 3 months. During the dry season the tankbed serves as grazing ground. The lowest part near the tankbund with the most fertile soil, containing a high percentage of clay, is cultivated by all three villages (Gatlagollahalli, Gatlahalli, and Baraka).
About five years back, the Forestry Department (re-)planted parts of the tankbed located farthest from the tankbund (i.e. the shallow area) with jali (Acacia nilotica), a species able to withstand incidental flooding. The Forestry Department will sell the trees when full-grown.

Vegetation in the riverbed

The small river meanders through the landscape of the watershed. In most places its width does not exceed 10 to 15 meters. In summer, most parts of the riverbed remain dry. Water is only visible in small parts of the riverbed and flows only in shallow streams. In this period the large amount of sand visible in the riverbed illustrates the ongoing proces of erosion and siltation.
The vegetation cover of the banks of the river is quite good (up to 80%). The owners of land bordering the river profit most from this vegetation. Common species are Pongamia, mixed with soapnut bushes. Often nereli (Eugenia jambolana) can be found. Scattered bamboo which is owned by farmers with adjacent fields is sold to basket makers.
The river water itself is communal property of the adjoining villages.

The vegetation cover of the riverbank was much better in earlier times and the diversity in species was higher. Although bamboo can still be seen, its abundance in earlier times provided not only bamboo to the basketmakers but it was also an excellent soil protector: bamboo roots hold the soil in the upper surface due to its superficial and deep rooting system. Also the vegetation cover of the nalas, small water courses on the hillocks leading water to the river, has diminished. Only small and dried-up bushes like rotani (Lantana camera), bandare (Dodonea viscosa), and beveru (Cassia fistula) cover the ground to a maximum of 5 %. On some places where the former nala vegetation completely disappeared the water did no longer keep to its staked-out course. Free game for the water run-off.

7.2.2 Trees in the agricultural area

Trees on the drylands

Trees are planted in the fields, either because of their products (production function), or as an ecological stabilisator that protects the soil from erosion (carrier function).
Fig. 7.5 shows the total number of trees on the drylands which are registered by the Village Accountant in 1976/77 and 1985/86.
In general farmers keep only a few trees mainly on the borders of the plot and on the bunds to reduce competition with food crops. Especially rice is vulnerable to competitors for light. Planting along the bunds leaves the fields clear for ploughing with bullocks.
Most common species are indigenous. To give an idea about which functions are fulfilled by trees in the agricultural area, a short description will follow of the important species:
- **Honge (Pongamia glabra)** A leguminous species which is most important as producer of green manure for paddyfields and fuelwood. Pongamia spreads naturally, very easy, and is usually removed when it spreads beyond its assigned places. Pongamia is hardy and drought-resistant.
- **Tamarind (Tamarindus indica)** This leguminous species is planted not only on the bunds but even in the fields, because its fruits are considered as an important cash crop. (flavouring rice menus.)
- **Soapnut (Acacia concinna)** This leguminous species needs other trees to wind its branches around. It spreads naturally. The dried fruits are made to powder to use for hairwashing.
- **Sisal (Agave sisalana)** Often this thick leaved bush is planted along the borders of the fields to keep the cattle effectively out of the fields. Ropes are made out of the dried leaves.
- **Jackfruit (Artocarpus integra)** This tree produces very sweet large fruits that are seldom sold as there is hardly a market for this product.
- **Mango (Magnifera indica)** The mostly High Yielding Varieties of Mango trees produce fruits. The leaves are used during holy hindu ceremonies.

Fig. 7.5 Trees in private ownership in Gatlagollahalli in 1985/86.

Total nr. of trees in:		**1985-86**
tamarind	- Tamarindus indica	30
soapnut	- Acacia concinna	6
coconut	- Cocos nucifera	46 (+0.05 garden)
mango	- Magnifera indica	14 recently planted
jackfruit	- Artocarpus integra	24
lemon	- Citrus limon	4
neem	- Azadirachta indica	1
honge*	- Pongamia glabra	0.10
nereli	- Eugenia jambolana	-
arecanut	- Areca catechu	4.09
Total number of trees		125

*= According to this figure, the number of Pongamiatrees is not very high. Though in reality they grow abundant. The Village Accountant does not keep accurately record of their number due to the very easy natural spreading of this tree species.

Source: Village Accountant of Bukkapatna, 1985/86.

As is clear from interviews with villagers, fruit trees are preferred in the drylands. They provide a secure income from the sale of the produce and provide often very good quality wood. Planting a tree can be a good investment: a tree can be cut and sold whenever in need of cash, for instance for a marriage, funeral, or for a festival.
As can be seen in the few nurseries in the kitchengardens, tamarind is a popular tree. The one-and-a-half year old seedlings will be planted in large amounts next year. Not only on the private wastelands but also on the drylands. Some farmers consider tamarind as a more economic crop than finger millet, mixed crops, or groundnut. However, these farmers often own also other drylands which can supply them the necessary staple food or millet stock for home consumption of the next year. Crop production for subsistance is considered to be the prime objective. Total reliance on off-farm opportunities is mostly considered too risky.

With figures obtained from the books of the Village Accountant it can be concluded that more trees have been cut than replanted in the drylands between 1976 and 1985. (As has been said before, the figures of the V.A. are not very reliable. E.g. the number of trees cut is very low, but no other figures are available.)

Fig. 7.6 *Trees planted and cut in Gatlagollahalli over the past ten-year period according to the records kept by the Village Accountant.*

1976 - 1985	planted	cut
tamarind	3	9
soapnut	1	5
coconut	4	17
mango	4	1
jackfruit	11	5
total	23	37

Source: Village Accountant Bukkapatna, 1976 and 1985.

Trees in the wetlands

In the wetlands farmers do not allow trees. They cause shade and consequently growth reduction of the annual crops. E.g. Rice is very vulnerable to competitors for light. Moreover annual crops are preferred. Pongamia trees and yakku trees (Glyricidia sepium), both leguminous trees, form an exception because the use of their leaves and flowers as green manure on paddy fields is highly appreciated.

Gardenland crops

The village area accomodates approximately twenty plots that in our definition can be considered as gardenlands, as all have crops which need year-round irrigation.
The oldest type of gardenland consists of different species mixed-grown in the same field. This system is based on a purely organic method of

farming. To give an example; one farmer is growing 190 arecanuttrees, 35 banana, 3 papaya, 13 coconut, 4 lemon and 3 small jackfruittrees along the border on one and a half acre. Another type of garden consists of betelleaves growing along the stem of two types of trees: harewana (Eurithrinaa indica) and hagese (Sesbania grandiflora), both producing fodder.
Several products are derived from these types of gardens e.g. fruits, fuelwood, fodder.
This type of gardens is only kept by farmers who also have other lands were they can grow the necessary foodcrops. Other problems are labour-intensivity, only once a year yields and wateravailability: The garden has to be irrigated all year round and especially in summer at least once every week.
The number of this type of gardenlands has been reduced in the last 20 years from 25 to about 5. Most farmers indicate drought as the main obstacle.
Other types of gardenlands are lands cultivated with mulberry and with socalled "British" vegetables like tomato or carrot. These have been introduced only recently. Mulberry is grown since about 5 - 10 years by seven families in the village. They keep silkworms which are fed with leaves (sometimes also the very young branches) of the irrigated mulberry crop (High Yield Variety M5 mixed with traditional varieties).
Mulberry plots occupy on an average half an acre. Such a plot yields enough for 30.000 worms (45-60 kgs cocoons), income (=yield minus expenses): Rs 1500 in 2 months. This is a good local income[6] if no problems occur with the very vulnerable worms.
ALthough their yield in terms of cash is comparable with the first type of gardens, some differences have to be mentioned. Mulberry is more vulnerable for drought and sicknesses. On the other hand, its labourinput is lower and it has several yields (=cash income) per year. Furthermore the mixed gardens have a life long benefit.

Kitchengardens

From the 140 households only seven households own small kitchengardens. The gardens are located in the village generally near the house. Their size never exceeds 70 m^2. The crops grown are vegetables and fruits consumed in the household. Sometimes the only purpose of the garden is to nurse tree seedlings. Fig. 7.10 lists the crops of the gardens we noted down in the dry season. Therefore most of the crops mentioned are perennial crops. In the rainy season additional vegetables are grown.
The choice of treeseedlings indicates the preferences of the different households for certain species. Our own research did not yield anything conclusive on the former number of kitchengardens. It is possible that the number never was higher than seven, e.g. due to a shortage of land in the closely spaced village.

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[6]. A landless labourer earns 8 Rs a day, a woman 6 Rs.

Fig. 7.7 The crops of seven kitchengardens in the dry season in Gatlagollahalli in 1987

Kitchengarden:	1	2	3	4	5	6	7
size of the garden (in m²)	4	70	35	20	20	30	4
Number of treeseedlings:							
Tamarind - Tamarindus indica	70	50		x	x		
Arali - Ficus religiosa	3						
Mango - Magnifera indica		1					
Neem - Azadirachta indica			1	1			
Coconut - Cocos nucifera				x	x	x	
Jackfruit - Artocarpus integra					3		
trees:							
Papaya - Carica papaya		12					
Castor -	x	x					
Soapnut - Acacia concinna			x				
Hagese - Sesbania grandiflora							x
Haliwana - Erythrina indica							x
vegetables:							
Nugge (green Leaves)		*					
Cucumber		*					
Danthu (spinach)					*		
flowers:							
Jasmin			*	*			

"x" indicates number not noted down.
"*" indicates number not of any value

Source: fieldwork 1987

7.2.5 Management practices with regard to trees

Several relevant mangement practices with regard to treeplanting, ownership and yield prevailed in Gatlagollahalli. Especially the Amaraj planting system provided the village an additional income. Further these trees offered villagers and animals shade. As is true for each kind of vegetation these practices contributed to soil conservation and enriched the biotic environment e.g. birds could nestle which helped in limiting insect-plagues.
One of the reasons why the availability of the treeproducts had declined is that most of the practices are no longer intact. Therefore, we think it useful to pay attention to these practices:

The Amaraj system

A special government measure in the early 20th century enabled the village community to plant trees on government lands, called Amaraj trees. The species planted were often fruit trees, like coconut or tamarind. The planting of new trees was mostly done along the road to the former

gomal/forest land, and in the riverbed. Beside their fruitbearing, the shade they provided was appreciated. The fruits were collected and auctioned under the auspices of the Shanbogue. On the proceeds, taxes had to be paid to the Tachildar (Revenue Dept.). The remaining money could be used by the villagers for communal purposes (for instance festivals, or temple-maintainance).
In 1957 the village officials (Shanbogue, etc.) were abolished; their tasks fell into the hands of the Village Accountant, living in another village. Because he did not visit the village very frequently, he was not familiar with every tree. Consequently the control over the trees became less strict and their yield diminished due to illegal lopping. Even tree-felling was to a large extent unnoticed by the Village Accountant.
The Amaraj system was abolished in ...In a neighbouring village some of the former Amaraj trees came under Revenue Department-control. But - according to Gatlagollahalli-leader Rao - landowners encroached trees adjacent to their land. The new Village Accountant did not protest because he was not familiar with the exact property-boundaries.

The Sannad system

Thirty years ago the Patel planted, together with 30 other Gatlagollahalli-inhabitants, some 500 Pongamia trees near the tank on government owned land. For this they received a certificate from the Revenue Department. Tax had to be paid to plant a tree on the government-owned land, but the tree as well as its yield remained in private hands, whereas for the Amaraj system the tree was in governments hands except for its yield.

Gundutopu-system

In ancient times villagers could use the products of trees on lands not fit for cultivation - mostly lands on rocky areas near the village - for fuelwood (called Gundutopu lands). However the lands with the trees were acquired by the government who auctioned the yields of the trees. It is not possible to use the trees anymore.
In Gatlagollahalli we could not find any remains of the Gundutopu-system. In Gatlahalli, the neighbouring village, 1 acre with Pongamia trees still exist under government rules.

Other trees owned by the community

Formerly trees were planted in the village, and used under an Amaraj-like management system. In this case not only the trees but also the ground was communally owned. In Gatlagollahalli, no such trees owned by the community can be found at present.

7.3 KANITHALLI'S TREE WEALTH

For purpose of reference a general idea will be given of the condition of forest and tree wealth in Kanithalli- village in Kolar district (see fig. 6.12) after which the dynamics of deforestation will be illustrated in this particular case.

7.3.1 Trees in non-agricultural areas

Several units can be distinguished according to their function, ownership, and management:

Forest

Parallel with the south side of the village a forest is situated on 3 km 'uphill'. It belongs to Sumbaragiddu Kaval State Forest (= "reserved" forest), which is only partly located in Kanithalli watershed. The reserved South Forest is not open for public use. Forest watchers (one on every 10 ha) catch every tresspasser, who is subsequently deprived of his or her tools.
Untill about 1960 the Forest Department managed this land under a workingplan which prescribed a mixed species-forest. According to the older villagers in earlier times the forest consisted of big trees. (longer ago than in Gatlagollahalli due to higher pressures also of urban demands on a smaller area. Species like jidi (Semecarpus anacardium; Anacardiaceae) and marredemarre (Aegle marmelos, rutaceae) are mentioned, which belong to a typically dry-decidious forest type.
In 1965, however the forest department clearfelled the whole forest and replanted it with two species Eucalyptus and simetangedi (Cassia siamea). From the number of stoolings visible it can be deducted that the Forestry Department already harvested two to three times since.
As regards the soil-works, the forest seems well-maintained.
The decline in forest quality (fig. 7.5) as described for Gatlagollahalli is partly applicable for the forest of Kanithalli as well. It will be clear that considering a eucalyptus plantation, one can hardly speak of natural forest on the southside of the watershed.

Gomal

The area between the forest and the southern border is partly gomal (grazing ground) and partly encroached drylands. Information for the reconstruction of the gomal-history was hard to gather. The number of acres mentioned varies with each respondent.
In total the gomal was 300 acres. Decline in the area (converted into drylands) was due to encroachment of at least 30 acres. The area was (even again) limited due to the "Land to the Landless"-programes which were executed from 1075 onwards at the cost of the gomal, at that time communal property. In total about 160 acres of gomalland have been encroached by villagers. Fifteen years ago part of the gomal (30 acres and later again 30 acres) was replanted with eucalyptus in cooperation with the Forestry Department. The profit was shared between the Department and the Group Panchayat.
Therefore the present gomal consists for the major part of small eucalyptus bushes which are not maintained at all. Scattered over the area small often thorny bushes can be found. No bush or tree exceeds a hight of two meters.

Wastelands

In Kanithalli there are hardly any privatly owned wastelands like in Gatlagollahalli probably owing to a less rocky surface. The very few spots have in common a deserted well with in and around it some small bushes and (often) jali (Acacia nilotica) trees.

Roadsides and villageground

While entering Kanithalli one gets an even greener view than in Gatlagollahalli. A closer look shows that this green color is not caused by roadside trees but by the numerous grape gardens. The gardens are bordered by coconut trees on one side of the road. On the other side drylands are situated with some Pongamia trees along the borders of the field. Actually almost no trees are left on the road.
A plateau with a large Banyan and Neem tree is present in the village. In the village some nine trees owned by the community can be found.

Vegetation in and around the tank

The vegetation along a small stream, which flows just under the tankbund, gives the bund a green appearance. However, also here like in Gatlagollahalli the neerghanti (the man who distributes water of the fields) removes all tree seedlings to prevent root-penetration of the bund. The trees along the remaining water course are all private property.
Because of the ongoing drought the tank has fallen into disuse. As a result, the vegetation of the tankbed declined. A flush of green grasses can hardly be found anymore.
The number of different species along the tank shore is considerably smaller than in Gatlagollahalli. Natural spreading decidious species like Jali (Acacia nilotica) and the leguminous Pongamia tree are most common. At the end of the tank in the tankbed, Jali was planted as a common property unlike the situation in Gatlagollahalli where the the Forestry Department planted the trees. However these trees were cut by a small group of influensive farmers as if it was their own property, and sold to the stone slab makers of a neighbouring village.

7.3.2 Trees in agricultural areas

For all species holds that their numbers are small compared to Gatlagollahalli. Hardly any large trees can be found.

Wetlands and Gardenlands

Not only annual crops can hardly be found in the wetlands also almost no trees are present, even no natural trees, which probably indicates a depleted state of the wetlands with regard to possible vegetation.
Compared to Gatlagollahalli the gardenlands receive a lot more attention. However this is not in favour of the number of trees. No traditional type of gardenland can be found in Kanithalli. Since already about 60 years back "english" vegetables are grown for the urban markets. Grapegardens can be often seen and mulberry is more often cultivated since earlier times than in Gatlagollahalli.
However the attention we saw in Gatlagollahalli for fruit trees in the drylands has been replaced sometimes by attention for fruit trees in the gardenlands. On the unirrigated part of the gardenlands a few big jackfruit are grown, occupying about half an acre. The advantage is that trees can be watched during ripening on these often nearby fields (for instance tamarind, jackfruit, Pongamia, nereli trees). The gardenlands in Gatlagollahalli are more remote from the village.

Drylands

Compared to Gatlagollahalli, the Kanithalli-drylands look barren and eroded. The area did not get much attention the last few years, due to the ongoing drought, among other factors. Most emphasis has been put on the gardenlands. This barrenness is strengthened by the view of the many eucalyptus plantations on the drylands. Eucalyptus is a very thin tree that does not allow any undercover. Therefore the soil is very often exposed to the eyes. The most common species is jali (Acacia nilotica. This leguminous, not much shade causing tree can be found on the bunds of agricultural fields.
On the borders of the drylands and on other places in the village we found kalli (Euphorbia), a very drought-resistant bush. Together with jali, and Pongamia this indicates a dryer situation than in Gatlagollahalli. Our global investigation revailed a lower fertility due to further erosion and a with its many small stones at the surface a dried out appearance.
Due to practical reasons no exaxt information could be gathered about the number of trees in drylands from the Village Accountant nor about the number of trees cut or planted. We had to work with the oral information of older villagers.
In Gatlagollahalli tamarind is abundantly available on the drylands, whereas in Kanithalli just a few are found. Preference is given to Eucalyptus trees.

Kitchengarden

In Kanithalli nothing resembles the kitchengardens in Gatlagollahalli. Hardly any vegetables or trees are grown for homeconsumption near the houses. Only one coconut tree is grown in front of each Janata house. No tree nurseries are kept near the houses. If people do try to raise seedlings, the most optimal place is consideredd to be in the vicinity of a well in the gardenlands. Very seldom vegetables are grown here solely for homeconsumption.

Tree management practices

In Kanithalli the produce of some nine Amaraj (see 7.2.5) trees, six tamarind and three mango trees, is annually auctioned. The proceeds are put on the bank on a village account. For us, as was the case for most villagers it remained unclear where the money is going to be used for.

7.4 FUELWOOD SCARCITY

Deforestation and the fuelwood crisis are obviously closely linked. However it will be made clear in this paragraph that the two problems are not identical. To understand and effectively attack fuelwood scarcity, it is crucial to understand what is happening to local forests and why. Questions like to what extent villagers make use of the forest for fuelwoodpurposes and how this affects the forest, will be answered.

7.4.1. Fuelwood demand

Villagers collect fuelwood for different purposes:

1. Private use:
   - Domestic: cooking food, hot baths, extracting oil from Castor and Pongamia pods (for these purposes only wood with high caloric value can be used), preparation of arecanuts for market, preparation of soapnut-powder, cooking food on festival days like marriages or funerals.
   - Small-scale enterprises: pottery, blacksmith
2. for selling:
   - to stone slab-makers. (To be able to quarry stones the vegetation (!)- and soil-cover has to be removed. Besides that, fuelwood is necessary for the quarrying proces itself)
   - on the market of a nearby town.

   In Gatlagollahalli most of this fuelwood-collection is done by a quite well organized group of approximately 40 wood cutters. They operate in the area north of Gatlagollahalli. The group collects every day, although only weekly or once every two weeks on the same spot. The species collected by them most frequently is a shrub called Lantana (easy to cut and often the only species without thorns and available in sufficient quantities). The wood is carried to the market, generally by themselves, or by bus or truck. Of course the latter reduces the actual income. This type of work offers poor and landless a chance to earn cash in the dry season when no other agricultural labour is available. They do not have a licence, so, often, they gather illegally from the state forest, sometimes in collusion with forest guards who are supposed to protect the forest.
   Theft of wood as a means of survival is becoming of growing importance for more and more villagers in this area.
   In Kanithalli villagers collect fuelwood for comparable purposes, although the resources are much smaller and people can only resort to illegal exploitation. The collected fuelwood is mostly sold to other villagers. Stone-slab-making in Kanithalli is not as important as in Gatlagollahalli.

Not only villagers make use of the biomass resources. Urban fuelwood demands and industrial demands compound the pressure on forests. Before taking into account the impact of these external demands and discussing the fuelwoodproblem, we will first concentrate on the fuelwood sources of Gatlagollahalli and Kanithalli.

7.4.2 Fuel sources

Fuelwood is mainly derived from trees and shrubs on agricultural and non-agricultural land. Minor sources like cowdung, dried leaves of coconut

trees and stalks of mulberry (left over after removal of the leaves for silkworms) form additional sources of fuel close to the house. These latter products may be insignificant in terms of total biomass, they serve special purposes or can be kept as a reserve-fuel during the time collection of fuel is too much time consuming. E.g. in the dry season households try to collect as much fuelwood as possible and store it on top of their dwellings for use during wet periods when other work is more important. In this period minor sources are of greater importance. Furthermore minor sources serve special purposes e.g. sticks to kindle the fire.

Fuel sources in Gatlagollahalli

People generally collect fuelwood as dried branches or twigs from trees and shrubs scattered around their farms and throughout the countryside. Fig. 7.8 illustrates the supply of fuel of each land use type in Gatlagollahalli. In general any tree might be used for fuelwood, if dead.

Fig. 7.8 Possible sources of fuel in Gatlagollahalli.

Land use type	**sources of fuel**
Drylands	Trees: dried twigs and branches of all non thorny trees. Most important are Pongamia, jackfruit, and tamarind. Sometimes a whole Pongamia tree is cut to serve as fuelwood. Agricultural waste: straw, dried shells of pongamia fruits, hay of mixed crops.
Wetlands	Trees: dried twigs and branches of Pongamia
Gardenlands	Trees: dried twigs and branches of all trees, dried leaves and shells of coconuttrees and arecanuttrees Agricultural waste: mulberry stalks.
Roadside, riverbed, forest.	Trees: all naturally-growing trees and shrubs In forests mainly Pongamia and Lantana

Source: fieldwork, 1987

Fuelwood collection

Not only the question what is collected, but also how fuel is collected determines the way fuelwood scarcity contributes to the deforestation-problem. In most of the Gatlagollahalli-families women, assisted by children, are responsible for the collection of fuelwood. They go to the forest once or twice a week to collect a headload of fuelwood (ca. 15 kg). On an average this will take about 3-5 hours[1]. The richer households

[1] The time consumption is hard to assess as fuelwood collection is often combined with other work like cattle grazing or done during the walk to and from the agricultural fields.

often employ a servant to collect fuelwood. Families owning a bullock-cart use the cart, once every few months, to collect fuelwood in large quantities.
During the period cattle is grazing, the herdsman collects fuelwood while looking after the animals, which has its implication for the area where the fuelwood is or can be collected. This is restricted to places were fodder is available, e.g. not on top of the hillocks. In times when labour is scarce this will severely effect the availability of fuelwood in grazing areas.
Fuelwood collection used to be strictly a women's and children's task, but nowadays divisions of labour are breaking down. Men are becoming increasingly involved in this time consuming work, especially where it concerns collection for commercial purposes.

Fuel sources in Kanithalli

Fig. 7.9 illustrates the supply of fuel from each land use type in Kanithalli.
The diversity of treespecies used for fuelwood is less in Kanithalli than in Gatlagollahalli. This is not very surprising if we compare the number of different species in the area (see tree wealth 7.2 and 7.3). Further the caloric value of the available species is less than in Gatlagollahalli. Both features reduce the quality of the fuelsources. A high diversity of species reduces the risk of exhaustion due to causes like drought, deseases etc.
In contrast, the number of different agricultural wastes suitable as fuel has increased in Kanithalli.

Fig. 7.9 Possible sources of fuel in Kanithalli.

Land use type	sources of fuel
Drylands	Trees: dried twigs and branches of all trees. Most important trees are eucalyptus, simetangedi, jali, and Pongamia. Agricultural waste: straw, dried shells of Pongamia.
Wetlands	only some small shrubs.
Gardenlands	Agricultural waste: branches of grapes, stalks of mulberry, crop waste (chillies, millet (jowlar), mustard seed).
Roadside, tank-bed	Trees: all naturally-growing trees and shrubs.
Forest	Trees: Eucalyptus and simetangedi.

Source: Fieldwork, 1987

Fuelwood collection in Kanithalli

In Kanithalli men and women, with help of children are almost equally responsible for the fuelwood-collection. In a few cases children (sons) do the work alone. As in Gatlagollahalli, wood is collected generally twice a week. Villagers collect mostly one headload (15 kgs) which takes them two to four hours.

7.4.3 Fuelwood problem

As stated in the introduction (7.1) in general terms fuelwood scarcity is a problem for those who do not have access to sources that supply fuelwood in a quantity that meets their demands. In 7.2 and 7.3 on tree wealth we saw that all sources have undergone changes with regard to their biomass-resources.
Although in our study we did not conduct a quantitative analysis of demand-supply ratios, through interviews with villagers we could define other indicators illustrating sufficiently the pressure on scarce fuelsources: increase of walking distance, felling of fresh wood in stead of dried wood which is more work and yields wood of lesser quality, collection of minor wood species with regard to caloric value (light soft wood in stead of hard wood) or a turn over to other biomass resources like cowdung, hay or biogas (clearly, the financial investment counterbalances the freely avialable other biomassresources).
Thus, if fuelwood-cutting does not yield enough fuel in relation to the time spent, people turn over to lower quality wood, roots, crop residues, dung, and other combustible materials. These lower-grade fuels are less convenient and less flexible for cooking. They may take less time to collect, but they make more work for the cook who must take greater care in feeding and tending the fire.

The fuelwood problem in Gatlagollahalli

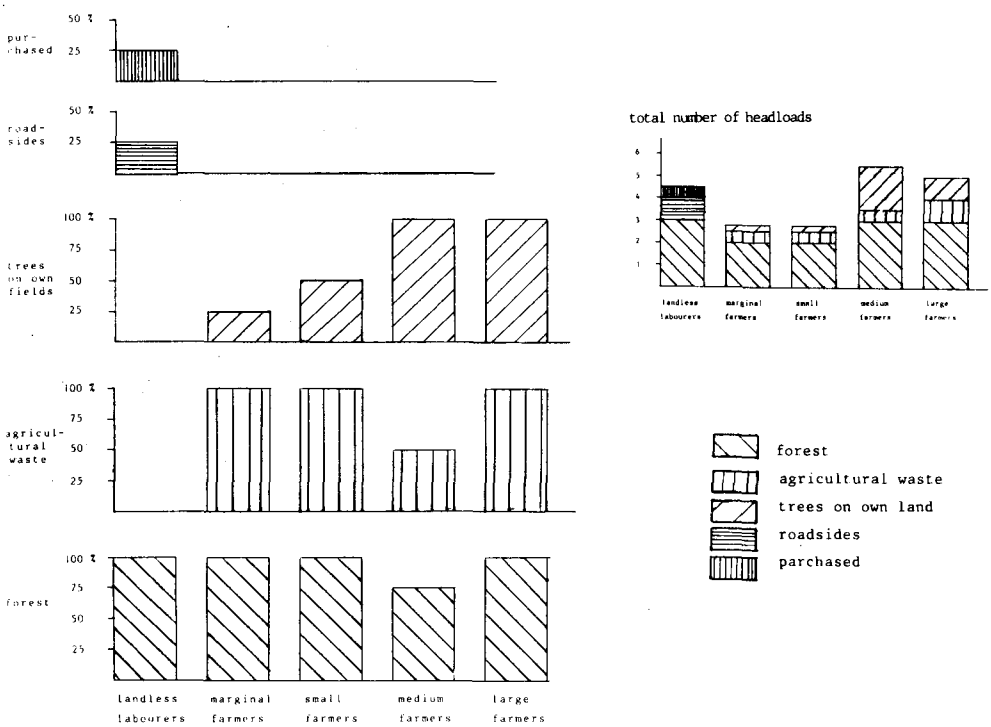
Wood is the dominant fuel in Gatlagollahalli for domestic use (cooking, hot baths).
Fig. 7.10 concerning fuelwoodsources for different categories indicates that the forest is the major supplier of fuelwood for each category.
As is clear from fig. 7.10, all families make more or less use of other biomass materials beside trees from the forest.
As mentioned cowdung is hardly used in the village, indicating that up to a certain level fuelwood-availability is still quite good.
However for all categories, except the landless, also other sources, which are all privatly owned, are of importance: agricultural wastes, own trees. One or two large landholding families, not one of the respondents, are buying kerosine.

The total number of headloads gives an indication for the importance of each separate source. For each source the total number of headloads collected has been given. This illustrates the number collected is not a static figure. There are differences in categories. Agarwal (1986) states that in cases of shortage, poorer families use less fuel (The category of landless is in contradiction with this).

How did the change in the condition of the sources (already described in general in 7.2 and 7.2) influence the fuelsupply over the years for the distinguished categories?

Women made clear that the forest used to be a more important source of wood. With time the widespread clearing of forest and grazing lands for agriculture severely reduces the available forest area. Walking distance to the forest doubled in 10-20 years and the quality of the wood decreased. The increase in walking distance is thus, that villagers now prefer to cut fresh branches from bushes closer by. Collection of small shrubs like Lantana camera for use as fuelwood has become a widespread practice in Gatlagollahalli. From Gatlagollahalli to the Siddherabatta-forest is a ten-miles walk these days, whereas some 40-60 years back forest could be found on a distance of 1 mile.
Hardwood species (much in demand because of their high caloric value) disappeared.

Fig. 7.10 Percentage of households of the distinguished categories using different fuel sources; the average number of headloads used per week per household per fuelsource and the total number of headloads.



notes fig. 7.10:
1. Each quantity mentioned is converted into headloads per week e.g. 1 cartload is assessed 20 headloads, 2 baskets is 1 head-load. 1 headload is ca. 15 kg.
2. In the case of agricultural waste from the own fields, no distinction is made between different types of crops (hay and others), as this information could not be deduced from the answers in the questionnaires. Incidentally however, coconut leaves (two large farmers) and mulberry (one small farmer) were mentioned as specific sources. Moreover, hay (from redgram, mustard, mulberry) was mentioned regularly as agricultural waste-source: four times in cat. II, thrice in cat. III, twice in cat. IV, and once in cat. V.
3. In cat. landless, the total quantity of headloads a week is exceptionally high; an explanation for this eludes us.

Though fuel is not seen as a major output of the drylands the decrease in tree cover (7.2 & 7.3) effects the general fuelsupply. In fig. 7.12 and 7.13 the number of trees in privat ownership is given. The large farmers have more trees to their disposal as the smaller landholders.
In Fig. 7.6 numbers of trees planted are shown. Though fuelwood is often not the reason to plant these trees - all choosen species are fruit trees - firewood is produced as a useful by-product.
Furthermore the quantity of agricultural waste, often mentioned as the second most important source, diminished. A change in cropping pattern with less mixed crops and a change in crop varieties such as High Yielding Varieties of millet with smaller stalks deminished the total supply from this source. Moreover due to drought the production of the agricultural fields is less.

Although uptil now emphasis has been put on household fuel demand in Gatlagollahalli, according to the villagers stone slab making consumes the bulk of the fuel from the communal property resources like the forest.

Fuelwood problem in Kanithalli

In Kanithalli the situation is different. More alternative sources of fuel are used, for instance kerosine and biogas. Both of the large farmers-respondents can rely to a great extent on this last source for their fuel-demand. More than is the case in Gatlagollahalli people buy fuelwood. Cowdung is used in larger quantities. The walls covered with cowdung-cakes testify to its importance as a fuel source.
From fig. 7.11 it can be concluded that the major supply is derived from the forest/gomal for almost all categories, except for the large farmers.

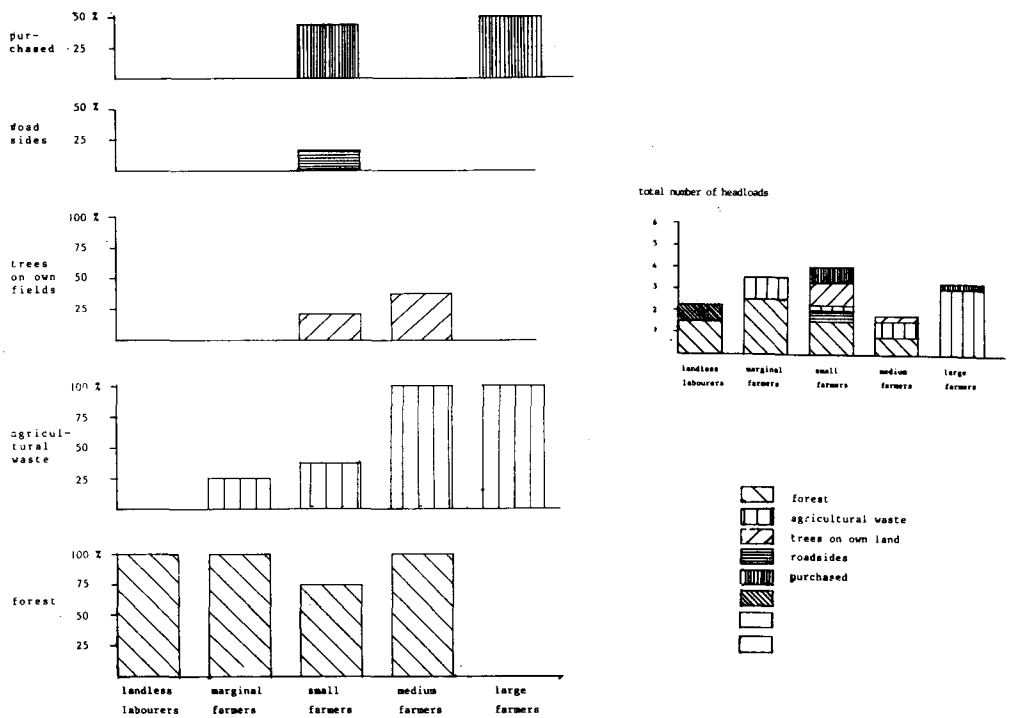
This supply is not derived from natural forest, which is not available anymore (see 7.3). Although villagers are not allowed to collect fuelwood in the gomal, only sporadically a Forest Guard will try to hold back the villagers due to the deteriorated state of the Eucalyptus trees . The Forestry Department considers only the Reserved forest with Eucalyptus, which is at ca. 2.5 km, worth protecting. Forest guards often take the implements from villagers if caught in the "forest".
Large farmers turned to biogas which indicates that compared to Gatlagollahalli the free woodcollection in the forest/gomal is outweighed by the financial investment for a biogasinstallation. This indicates that it is very labourintensive to collect fuelwood.

Even if large farmers own trees, they often prefer to collect wood free of charge if they have labourers or time. However farmers with own land also mainly rely on fuelwood collection in the forest. They reported that their needs could be met easily by the forest resources, although a larger landholding often accomodates more trees (fig. 7.13). These are preferred for other purposes such as fruitproduction.

Also other categories switch to other more accessible sources: small and medium farmers also make use of kerosine (whereas in Gatlagollahalli only large farmers) and compared to Gatlagollahalli more use is made of agricultural residues.

Changes in the agricultural system also had its impact on the fuel supply. The introduction of grapes meant at the same time an introduction of fuelwood as a byproduct e.g. branches of grapes[2].

Fig. 7.11 Percentage of households of the distinguished categories using different fuel sources and, the number of headloads used from each of these sources and the total number of headloads in Kanithallt.



Source: fieldwork, 1987

[2] Grapewood is of low caloric value. It produces a lot of ash, which increases the work of the cook when cleaning the stove.

notes fig. 7.11:
1. Roadside and riverbed are not mentioned as a source of fuelwood. This may be due to the way this collection is done. No special trip to the fields is made to collect fuelwood in these land use types. But during other work walking to the fields etc. all materials are collected.
2. In the case of agricultural waste from the own fields, no distinction is made between different types of crops (hay and others), as this information could not be deduced from the answers in the questionnaires.

The number of indigeneous multifunctional trees is much smaller than in Gatlagollahalli (compare fig. 7.12 with fig. 7.13 in which the total average number of trees per household is given)

Quit a few farmers grow small Eucalyptus plantation on their own drylands. Sale of Eucalyptus provides them with ample cash. Although not grown for home consumption it is not uncommon that these families use trees from their own fields. Farmers earn a good cash income with growing Eucalyptus. This leads to the paradoxal situation that for this reason people will not use their own tree stock for fuelwood purposes. But resort to forests or other fuelsources to safe their tree stock for sale.

Thus far, one can conclude that especially in Kanithalli, outside demands determine how forests are used and maintained.

This household fuel analysis is of importance to see what strategies are taken up by different categories to fulfil their basic needs. Can a shortage imply a better maintainance of the remaining resources?

Social consequences of fuelwood-scarcity

Although all categories of landholders in Gatlagollahalli and categories marginal, small and medium farmers in Kanithalli reported to rely on the forest resources, the implications of the fuelwood scarcity are more serious for the marginal groups than for the larger landholders.
Which strategies are choosen to attack the problem depends on factors like access to other sources, labour availability, income, abilitity to do investments etc. Fig. 7.14 shows the possible strategies as noted in Gatlagollahalli to the fuel sources and in Kanithalli for each of the different categories landholders.

Landless labourers and farmers with small marginal plots are not able to grow their own fuel and thus fully depend on common property resources, where they can gather fuelwood. This implies a growing workload for the collectors. A few of the really poor households reported a shortage of labour for the now more-time-consuming fuel collection. Sometimes even one meal a day instead of two or three are cooked, to safe fuel. In Kanithalli poorer households consume inferior fuels like crop wastes which are gathered with great human drudgery.

Since wood became a market commodity (urban industrial demands), landless labourers and tenant farmers are denied traditional rights to collect wood or residues on the larger estates. Moreover, they are not in a position to substitute firewood with alternative fuels that require cash expenditure.
In Gatlagollahalli the larger farmers substitute fuelwood with kerosine or employ labourers to collect, both reducing their income. In Kanithalli

Fig. 7.12 Number of trees in privat ownership (regardless the size of the land owned) on the agricultural fields of Gatlagollahalli in 1986.

Gatlagollahalli	Landownership-category					
	landless	marginal farmers	small farmers	medium farmers	large farmers	Average number per species
DRYLANDS						
Tamarind	-	5	3	7	25	8
Soapnut	-	1	1	1	3	1
Pongamia	-	23	10	34	125	38
Mango	-	-	-	1	0.5	0.5
Neem	-	3	2	2	5	2
Jamun	-	1	-	-	-	0.5
Jackfruit	-	0.5	-	2	1	1
WETLANDS						
Coconut	-	1	8	8	17	7
Bamboo	-	-	-	-	0.5	0.5
Total average-number of trees/ household		33.5	24	55	177	58.5

Source: Village Accountant of Bukkapatna, 1986

Fig. 7.13 Number of trees in privat ownership (regardless the size of the land owned) on the agricultural fields of Kanithalli in 1986.

Kanithalli	Landownership-category					
	landless	marginal farmers	small farmers	medium farmers	large farmers	Average nr per species
DRYLANDS						
Tamarind	-	-	0.5	0.5	1	0.5
Pongamia	-	0.5	2	9	-	2
Mango	-	-	0.5	-	-	0.5
Neem	-	0.5	-	0.5	-	0.5
Jackfruit	-	-	1	1	-	0.5
Eucalyptus	-	-	0.5	1	-	0.5
Jali	-	0.5	-	-	4	1
Beli	-	0.5	-	-	-	-
WETLANDS						
Coconut	-	-	3	2	5	2
Areca	-	-	0.5	-	-	0.5
Total average-number of trees/ household		2	8	14	10	8

Source: Village Accountant
note: All figures have been rounded off, as their number is not very precise. The Village Accountant is not familiair with the actual situation. Only 0.5 has been maintained to indicate the presence of treespecies in small quantities.

the well-off either purchase fuelwood or substitute it with kerosine or biogas. In contrast to large farmers in Gatlagollahalli, non of the large farmers in Kanithalli rely on communal resources. They use domestically produced biogas. Beside the necessary financial investment the installed biogas plants are only viable for the large farmers because three to four heads of cattle are considered to be a minimum need for a family-sized biogas plant. The inadequate number of cattle owned, or even the total absence of cattle ownership enlarges the differences between the categories even more.
Although it can be argued that this may help the poor indirectly by making more fuel available for the poor, this argument has not proved true. The rich merely increase their energy consumption (compare the total number of headloads for smaller and larger farmers fig. 7.10 and fig. 7.11) or replace fuelwooduse with kerosine. Even the 'large' farmers of Gatlagollahalli are financially unable to start a biogas plant due to a different farming system with less cash crops.

There is one more (major) impact of the fuel shortage. The shortage caused - although together with other factors like labour shortage - a skip of home-made products like Pongamia oil (used for lamps and animal diseases), castor oil (for hair), soapnut powder (hairwashing powder) and arecanuts (chewing) towards products bought in the shops. However people with smaller landholdings generally lack the cash to buy alternatives.

Fig. 7.14 Possible strategies for the landholding categories in Gatlagollahalli and Kanithalli.

Landhold. cat.'s	landless and marginal farmers		small, medium and large farmers	
	GGH	KH	GGH	KH
walking distance increased	*		*	
skip to other fuel sources outside, like kerosine, purchased wood		*		*
skip to biogas				*
skip to inferior fuel sources*	*	*		
derive more from private property			*	*
planting trees		*		
using less fuel: - less hot baths, - one meal a day - less cooking time - using a stove	*			

Source: fieldwork, 1987
note: no distinction could be made between the strategies of the 5 categories only 2 goups could be derived out of the results from the interviews.

Fuelwood-based small enterprises

Except for cooking, fuel is needed in the small enterprises of the village like the blacksmith and potter. Traditional crafts like blacksmithing need good quality wood. Buying fuelwood is a burden on their already small family budget. (No exact figures are gathered about the share of bought fuelwood in the budget). Formerly they could rely completely on the freely-gathered fuelwood.
Furthermore, stone slab making is an important income source in Gatlagollahalli during the dry season when no other agricultural work is at hand. It requires a large amount of fuelwood. The present depletion of the fuelwood-sources leads to a increasing timeconsuming collection and reduces the relative income thereby further endangering the security of livelihood of this group. The on-going drought adds to its stress.
Especially in Gatlagollahalli where labour demand is shrinking and with the rise of commercial fuelwood markets, landless labourers have come to rely on the wood trade for part or all of their livelihood.
Depletion of their sources, which are always common-property sources, will deprive them (again) of an income.
Starting a tile factory, an idea of the Gatlagollahalli-leader to increase local employment, is problematic, as the necessary quantity of fuelwood is not (abundantly) available.

It is clear that although we regard the fuelwood scarcity especially for the landless and marginal farmers as an extremely burdensome search for fuelwood, locals regard it as quite normal or as a far less-pressing concern than for instance the drought problem[3].
Reduction in women's work burdens and labour time, which may have little or no opportunity cost in monetary terms, in collection of what is customarily considered a 'free' item (fuelwood), would make it a low-priority item, especially where the decision on adoption rests with men. And if people do not feel fuelwood scarcity is a high-priority problem, they are unlikely to go to a lot of trouble to solve it.

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[3]. Part of this can be explained by the choice of a male respondent, by the way we interviewed. Women may be more aware of emerging scarcities as they are (still) the main gatherers and users of forest produce. Women's preference about which species to plant may differ form the men's. Other research also concluded that men preferred income-producing fruit trees; the women, on the other hand, want trees to produce fuel and fodder.

7.5 THE FODDER PROBLEM

Soon after starting the research it became clear that although in general drought was mentioned as the main problem, fodder shortage was often mentioned as an important problem as well. The present livestock population is simply too large to be kept on a sustainable bases. It is assumed by villagers from Gatlagollahalli and Kanithalli that livestock grazing and fodder gathering by people cause more damage to woodlands than fuelwood-cutting does. Grazing itself is even more threatening than collecting because the animals, especially goats, keep forests from regrowing by eating or trampling the tender shoots and seedlings.
To what extent drought was the main cause of fodder shortage or whether other factors influenced the availability, was our main question. To answer this question, we had to find out from which sources fodder is derived, which changes took place in the demand-supply ratio, what caused these changes, which were the consequences of these changes and for whom.

7.5.1 Fodder demand

The fodder demand depends of course on the number of animals (fig. 7.15) and the type of animal.

Fig. 7.15 Cattlepopulation in Gatlagollahalli and in Kanithalli 1987

	Gatlagollahalli	Kanithalli
bullocks	80	unknown
crossbreed cows	1	80
local cows	50	6
buffaloes	80	20

Source: Village accountants

Not all livestock can be fed in the same way. For instance buffaloes can graze on very short grasses, therefore more sources are available for them compared to cows. Sheep and goats are able to survive on (degraded) forest and grazing land on which other cattle can barely subsist. However goats are kept out of the forest to prevent them from eating young tree seedlings.
If a household owns only one or two goats, no time is spent to take them out grazing; instead they are stall-fed with branches from trees all over the area. Goats are the only livestock that can be fed on tree-leaves from almost any tree.
The farmers give priority to the feeding of the bullocks. They are always stallfed and get double the amount of fodder during heavy working periods (i.e. the kharif and rabi seasons). Milk-giving animals are also given priority due to the importance given to cash income from milk.
In general, the villagers prefer to feed their livestock a mixture of fodder types during the day. The mixture varies not only with the availability but also with the specific characteristics of the fodder: a steady diet dominated by one fodder type is not viewed as healthy for the stock. Rice straw, for instance, is used in limited quantities for cows

and buffaloes. It is too 'hot'(local slang) and is only fed in combination with ragi straw and groundnut waste. Each type of agricultural byproduct is used on a certain optimal time and for a certain type of animal.

7.5.2 Fodder sources

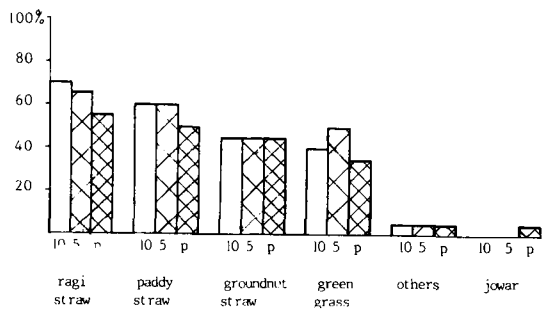
The farmers of Gatlagollahalli and Kanithalli derive their fodder from different sources, each with distinct implications for the environment. We distinguished between private and public sources to get inside into the linkage between availability and access:

- private sources:
  - byproducts of agriculture, mostly crop residues,
  - treefodder from privately owned trees,
  - vegetation growing on the bunds of the fields,
  - foddercrops grown in fields,
- public sources (communal or government-owned):
  - forest tree fodder,
  - undergrowth of forest, like grasses and shrubs
  - roadside-vegetation,
  - tankbed and -bund, riverbedvegetation.
  - pastures

Fodder sources in Gatlagollahalli

Livestock in Gatlagollahalli completely depends for its fodder on locally available resources. No fodder is purchased from outside the village. Up till now no fodder crops have been cultivated.
In fig. 7.16 an overview is given of the results of the interviews regarding the fodder types used at present, 5 years and 10 years back. Figures are given in % of the interviewed households using a particular type of fodder. No distinguishment has been made for the different categories.

Fig. 7.16 Percentage of households using particular fodder types at present (p), 5 years back (5), and 10 years back (10) in Gatlagollahalli.



Source: fieldwork, 1987
note: fodder trees are not mentioned due to the formulation of the questions in the questionaire.

Private fodder sources

Fodder from **agricultural byproducts** is composed of straw from ragi, paddy, groundnut, stubbles, weeds, undesired crop plants, etc. To give a rough idea of quantities: two cows can be kept on byproducts derived from 2 acres of Wetlands, or 4.5 acres of Drylands. These acreages supply the - on an average - necessary 5 cartloads of byproducts per year. The bulk of these products is reserved for summer feeding when no other resources are available. Extra feeding is given to lactating animals in the form of "oilcakes" which are made from shelves of groundnut.

Changes in the quantity of these byproducts mainly took place due to the introduction of High-Yield Varieties of rice and ragi (millet). These varieties are characterized by a much higher useable proportion of the total dry matter production, but also by a lower proportion of by-products. This reduces the amount of fodder available in the dry period. The spread of arable cultivation at the expense of the grazing area could, however, have a positive impact on the total quantity of byproducts. But at the same time the ongoing drought reduced the total output considerably which must probably explane the decrease in the amount of straw. Needless to say that due to the drought and the increasing pressure on the deminishing area grazing lands reduces the all year-round supply of 'natural' fodder on the remaining grazing ground.

Green grass on the banks and bunds is cut to establish a free water course. Although the main function of the vegetation on the banks is to protect the canal and terrace structure, the cutting practice provides of course very useful fodder.
Furthermore at the end of the harvest season, when crops are removed, cattle can graze the **stubbles** on the fields.

Land use intensification changes the role of weeds and fallow vegetation. The spontaneous growth of natural vegetation is a necessary feature in a fallow system to cover and protect the land during the seasonal fallow. Where irrigation all year round is introduced (gardenlands), wild vegetation has no useful role to play with regard to agricultural production. Its role as animal fodder is often neglected.

Fodder trees in the drylands are not very popular. Feeding leaves of trees to cattle is considered unhealthy. Neem leaves (Azadirachta indica) form an exception and are often fed to stall-fed goats. Tamarindus was told to be a good fodder, but this species is never used as such. It is more valuable for the villagers as a fruit producer.
In the wastelands adjacent to the drylands we found other interesting fodder species mentioned by villagers, like hippe (Madhuca indica), banyan (Ficus religiosa), neem (Azadirachta indica), bandare (Dodorea viscosa) - this shrub is browsed directly as it is low - , and nugge (Moringa oleifera). Villagers reported that fodder from all these species is mostly used to feed goats. Favorite species mentioned in hierarchical order are Banyan, Neem, Bandare, Jackfruit, Mango, Tuggli, Jali. No valid figures could be gathered on the nutricious value of these species. (Singh (1982) published a thorough study on the ecological characteristics of indigeneous fodder trees). In 7.2 changes in the vegetation have been described. As will be clear, these changes have their effect on the availability of fodder.

There are a few **tree species in the gardenlands** which are typical fodder suppliers. Of course, they perform additional functions, like providing shade to improve the soil moisture, supporting betelleaves, etc. Common fodder trees are hagese (*Sesbania grandiflora*) and haliwana (*Erythrina indica*), both leguminous species.
The number of gardens in Gatlagollahalli decreased significantly (see 7.2), which has its impact on the fodder provision from this source. Earlier it was an organically efficient multifunctional system including fodder and green grass production. Nowadays, only five (large) farmers still own such a labour- and input-intensive garden.

Hardly any **trees** are kept **in the wetlands** that specifically provide fodder, although the fields provide good possibilities. They are irrigated and consequently are able to yield fresh green leaves (for instance from Subabul cencena). However farmers are often unwilling to plant trees that cause shade to crops and thus reduce the crop-yield.

Public fodder sources
Forest, despite its degraded state, is mentioned as the most important source for grazing in Gatlagollahalli. The forest yields fodder from two different strata of vegetation: trees, and undergrowth. Trees already mentioned for the wastelands are browsed (mostly by goats) and grasses, appearing at the start of the rainy season, are eaten.
According to interviews with villagers, fodder is the heaviest demand made on the forest. Figures of an South-Indian village study considering the total ecosystem biomass subsribe this. 62% of the biomass was used as fodder for livestock, 8.6% was used as fuel and only 8.6% was used unleft.

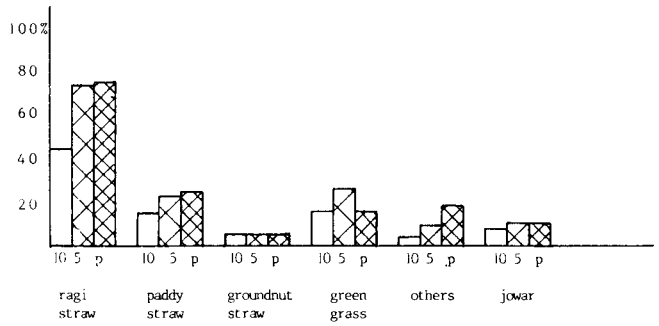
If there is no water in the **tank**, during the months December to June, grasses shoot up in the humid fertile soil (eroded from the catchment). Naturally this is first class fodder of a nearby, for everyone accessible, source.

Some of the trees near the **river** and along the **road** can be used for fodder. However, as stated before, whole branches with leaves have to be cut, if fodder from trees is used. People are not willing to do so if other sources still supply some fodder. Trees have more important long term functions. Therefore roadsides and riverbeds are more important regarding their undergrowth. Especially in the riverbed, which is shady and humid, the grasses thrive well. Roadside-grasses are kept short by all trespassers.

Fodder sources in Kanithalli

Unlike Gatlagollahalli, Kanithalli households not only rely on agricultural byproducts or green grass, but actually cultivate foddercrops to satisfy the demand. In fig 7.17 an overview is given of the % of interviewed households using different fodder types in Kanithalli.

Fig. 7.17 Percentage of households using particular fodder types at present (p), 5 years back (5), and 10 years back (10) in Kanithalli.



Source: fieldwork, 1987

Private fodder sources

Also in Kanithalli fodder from **agricultural byproducts** is an important fodder source. However their importance diminished[1] with

1. the continuous drought: farmers were not able to cultivate millet and paddy
2. change in crops: in Kanithalli High Yield Varieties replaced indigeneous varieties to a larger extent than in Gatlagollahalli. Fodder-availability decreased accordingly. Furthermore, the former mixed crops and millet fields were replaced by Eucalyptus plantations.

Compared to Gatlagollahalli, the number of different tree species in Kanithalli is not high and no arecanut gardens with fodder trees exist in Kanithalli. As holds for Gatlagollahalli, grazing or cutting of **grass** of the bunds, especially of irrigated fields, are important fodder sources.

With the introduction of crossbreed cows the farmers had to provide easily digestible fodder. Millet- and paddystraw is too rough for these animals. This is why two years back the Dairy Cooperative introduced **napir**, an irrigated grass crop, which is now commonly cultivated by owners of crossbreed cows. A fodder concentrate which also has to be fed to crossbreed cows is supplied to the farmers through the Dairy Cooperative. This "Buzza" is a liquid mixture of wheat, jowarseed, and aware. Other byproducts useful as fodder like mulberryleaves have been introduced. [2]

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[1]. Although at present more households indicated the use of agricultural waste than in earlier days, it is equally true that the amount of ragi and paddy-straw increased. To explain this phenomenon, a good understanding is necessary of the way the figures are collected. Figures from 'present' are most reliable.
The table illustrates that groundnut is not as important as in Gatlagollahalli. It is grown in much smaller quantities. Paddy is not grown in equal quantities with ragi. Part of the wetlands are even used to grow dryland-crops.

[2] Every five days the silkworms are removed from the 'leafbed'. The not fully-digested leaves can be fed to the cattle. The leaves are sensitive to putrefaction and therefore cannot be kept long. Fodder from sericulture is reported to be helpful in increasing the milk yields of the cows (Giriappa, 1986).

Public fodder sources

The **forest and gomal** are composed of hardly edible species. Eucalyptus is not browsible. Even seedlings are not often eaten by animals (sometimes by goats or sheep, but they are not allowed in the forest). This holds for simetangedi (...) as well.
Therefore cattlefeeding depends on small bushes, and of course grasses. The Kanithalli forest area is much more eroded than most of the Gatlagollahalli-forest. The quality of the grasses diminished likewise. One can find more 'straw-like'-species yielding low quality, less palatable fodder. This type of grasses often dominate the vegetation on the other common property sources as well, like the **tankbed, wastelands**, and **roadsides**. The other vegetation, the thorny bushes, are also not a favorite on the animal-menus.

Seasonal availability

Sources from which the fodder demand is satisfied vary according the seasonal availability of fodder types. In fig. 7.18 the composition of livestock fodder supply from different sources, in different seasons is given.

Fig. 7.18[3] *: Composition of livestock fodder supply from different sources in different seasons in Gatlagollahalli.*

Seasons	Summer hot season Jan.-Feb.	March-May	Kharif 1st wet season June-Sept.	Rabi 2nd wet season Oct.-Dec.
wetlands & drylands	*stubbles *weeds on fields after harvest	*stall-fed (straw)	*weeding *green grass-cutting on bunds	*weeding *green grass-cutting on bunds
gardenlands	*mulberry leaves *weeds-cutting *fodder trees	*mulberry leaves *weeds-cutting *fodder trees	*mulberry leaves *weeds-cutting *fodder trees	*mulberry leaves *weeds-cutting *fodder trees
forest	(*)	-	*	*
roadside	(*)	-	*	*
tankbed	(*)	-	-	-
tank offshore	(*)	-	*	*
wastelands	(*)	-	*	*

* = natural vegetation, grasses, leaves of trees, bushes, etc.
(*) = low (straw-like) yield, as vegetation is very dry.
\- = no use is made of these resources (except for grazing of goats and sheep during the summer season (March to May).

3. The figure is based on information from Gatlagollahalli, but the conclusions also hold for Kanithalli.

The limiting factor for the number of cattle which can be kept is the minimum fodder supply in a certain season. As will be clear from the figure 7.18 fodder shortage in the dry months preceeding the monsoon constitutes the chief obstacle to keep (more) cattle. In this season from March to May the smallest number of sources supply fodder and even in the smallest quantities (see fig. 7.18). Both buffaloes and cows are therefor stall-fed in summer, mainly on roughages (in Appendix 3 fodder needs of buffaloes are given). From March onwards trees develop a new flush of leaves. Lopping provides stall-fed goats useful additional fodder until the break of the rains and the appearance of a flush of early grass.

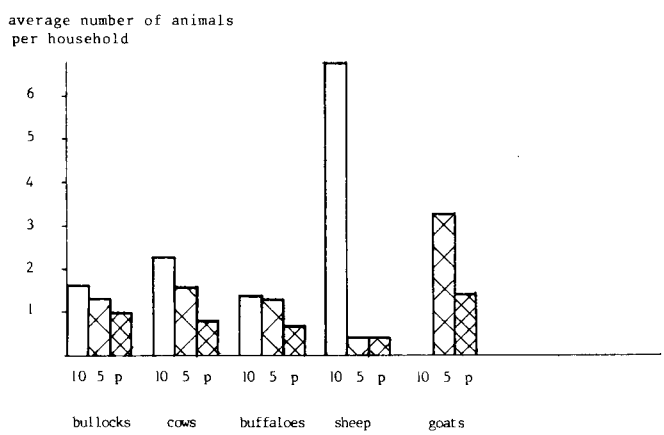
In the next paragraph we will pay special attention to the summer season and to how the different categories of landholders have access to these sources.

7.5.3 Causes of fodder shortage

The fodder resources of importance in summer have diminished to a large extent, causes are:

- an earlier increase of the animal population resulted in a decrease of fodder resources to such an extent that the present decrease of this population was inevitable
- the advancing surface erosion and gully formation in farmland and in forests, which has its impact on the grass-growth,
- the introduction of High Yielding Varieties,
- complete encroachment of grassland: in Kanithalli as well as in Gatlagollahalli gomal, traditional grazing grounds, used to be an important fodder source. Since then, it has been significantly encroached upon (In fig. 7.16 on fodder sources it is not mentioned because in Gatlagollahalli most of gomal was turned into agricultural fields more than ten years back).
- overexploitation of forests
- drought reduces crop productivity considerably

Fig. 7.19 Average number of animals per household in Gatlagollahalli present (p), 5 years back (5), and 10 years back (10).



Source: fieldwork, 1987

7.5.4 Reduction of livestock

Livestock in Gatlagollahalli

The present number of animals should be compared with those of five and ten years back. Fig. 7.19 shows how the number of each of the different animals decreased over the years.

Asked for the causes, the respondents mentioned a variety of reasons (see fig. 7.20). Some of them can be traced back to fodder-shortage. Others have more to do with an overall shortage of basic need which include a shortage of other financial reserves for which sometimes cattle is sold e.g. for health, labour needed for more urgent matters, funeral, marriages. For the owners of cattle, these are not the best of times, as drought and other developments (cf. infra) render cattle-herding problematic.
Analysis of the reasons farmers give for the decrease of cattle (fig. 7.20) over the past ten years warrants the conclusion that this reduction is indeed structural.

Fig. 7.20 Reasons for sale of animals mentioned by the interviewed households in Kanithalli and Gatlagollahalli.

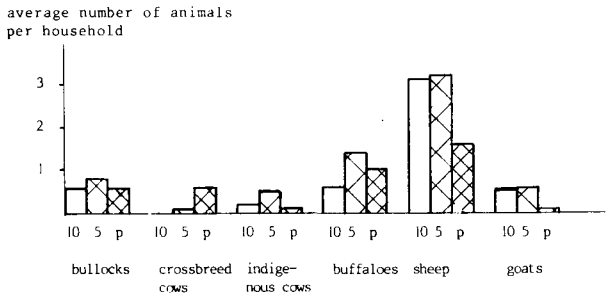
	nr. of households in Gatlagollahalli	nr. of households in Kanithalli
* money needed for household expenses	1	
* personal problems (medical)	4	2 (sickness)
* to repay loan	1	
* earn money (raising sheep to sell)	3	1
* because of disease	4 (buff + sheep)	3 (sheep)
* grazing of goats in forest not allowed	1	1
* shortage of grazing grounds	1	
* shortage of labour (split-up of family)	7	3
* lack of fodder	5	5
* to purchase bullocks	1	
* marriage of sister	2	
* no own land	1	
* money problems		1

Notes:
1. Selling of calves is never mentioned, although it is indissolubly linked with the milk gift.
2. After a few years bullocks are often replaced.
3. Lack of time and labour depends on the familiy size. Children are important for herding of the cattle.

Livestock in Kanithalli

Could we draw an easy conclusion about the reasons for the decrease of livestock in Gatlagollahalli, in Kanithalli things are not as simple. In Fig. 7.21 the average number of cattle per household is given at present, five years and ten years back.

Fig. 7.21 Average number of animals per household in Gatlagollahalli present (p), 5 years back (5), and 10 years back (10).



Source: fieldwork, 1987

The number of goats and sheep diminished, but this is mostly due to a disease some three years ago. The total herd was reduced and farmers had to start a new herd.
Generally, the number of cattle five years back was higher than 10 years back and at present. Why, is unclear.
The number of bullocks varied little over the years. If we compare these figures with the figures on livestock in Gatlagollahalli a higher number of bullocks is shown in the latter village, probably due to the introduction of tractors. The reduction of the livestock does not hold for the introduced crossbreed cows which are mainly fed with farm-produced products. The number of buffaloes and indigenous cows, dependend on the environment, diminished. This indicates a preference for milkproducing cattle instead of using the sparcely available labour for products like animal-traction, manure, good (buffalo-)curd etc.

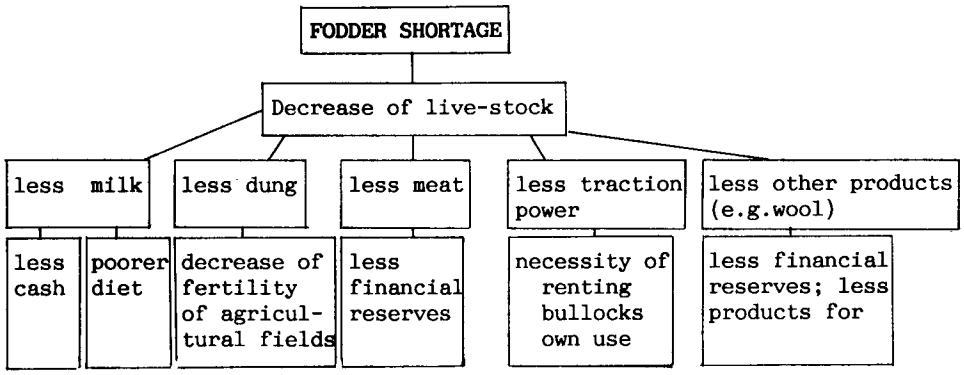
7.5.5 Consequences of changes in fodder supply

When the fodder shortage becomes more pressing, villagers can adopt different counter-strategies. For instance,
1. they can (have to) reduce the number of animals kept, or
2. they can reduce the number of animals kept and at the same time increase the quality of the lifestock, or
3. they can look for alternative fodder sources, like
   - buying fodder; purchased food reduces the dependency on far-produced food - but cash is needed
   - cultivation of fodder instead of food crops.

Depending on their social-economic position, either all three, or only the first alternative is open to the farmers (see social consequences).

A reduction of the number of animals has its consequences on the total farming system. (see fig. 7.22)

Fig. 7.22 Consequences of fodder shortage on the total farming system



Less milk

Milk is important as cash income, and in the diet as a source of protein (it is used in tea, coffee, curd, and as ghee on rice).
Already since the introduction of the Dairy Cooperative part of the milk that used to be consumed in the household, is sold. With its commercialization, milk has become an important product. Farmers now no longer select cattle according to their general functionality, but specifically on the basis of their milk-production.Compare: one buffalo yields 1-2 liters of milk a day, a cow 2-4 liters, and a hybrid 4 to 5 liters. Especially for crossbreed cows it is important that they get enough fresh fodder to produce milk. Otherwise repayment of the loan that was necessary to buy the cow becomes an insurmountable problem. In Gatlagollahalli five years ago six families owned a crossbred-cow; at the moment only one family still does. The others had to sell the cows, according to them, due to the fodder shortage.

Manure availability

Decrease of number of animals causes a decline in fertility of the agricultural lands. Manure supply is one of the first reasons in a farming system like this to keep livestock.
Consequences of a reduction in manure application without taking other measures to safeguard the fertility-level of the land can be seen in Gatlagollahalli as well as in Kanithalli. When fields are less fertile, their yield decreases, and they become more vulnerable to erosion. This could be clearly seen in the drylands of Kanithalli. Less attention is given to these fields. All available manure is applied to the gardenlands.

Because there is not much forest left in Kanithalli, cow manure is also used as fuel instead of firewood, as the round cakes of dung drying on the walls of the houses demonstrate. This practice reduces the availability of manure as fertilizer - leading to further erosion, soil runoff, dessicated fields, etc.
In Kanithalli the application of chemical fertilizers by large farmers reduces the dependence on manures. However in Gatlagollahalli farmers

pointed out that if less farm manure is added to arecanut-gardens in Gatlagollahalli and thus the organic content is reduced, more irrigation is necessary.

Manuring of the fields with compost is an old tradition. Compost consists of different components. Recently also litter of silk worms and other wastes of mulberry are added to the compost pit. However the quantities of most of the components have diminished over the years:

1. cow dung - in Kanithalli now in use as fuel
   - less cattle in Gatlagollahalli and Kanithalli;
2. other organic wastes: any organic matter is added to the compost pit. Nowadays a lot is used as fuel;
3. less green manure as there are less trees;
4. silt and soil use - although not added to the compost pit, silt, collected in the tank, has manurial value especially when it is applied in large quantities (40 cartloads/acre) to the fields. Presently the high percentage of sand reduces its quality. Washings on village sites and cultivated fields bring more sand (see drought problem).

With the expansion of the agricultural fields even more manure is needed. Change in the cropping pattern changed at the same time the demand: in Kanithalli grapes need, beside chemical fertilizer, soil and organic manure at least twice a year.

Less traction

The introduction of tractors reduces the dependence on animal traction. In Kanithalli three tractors were bought by large farmers; in Gatlagollahalli, no tractors were seen.
Bullocks are used for the traditional ploughing, tilling, and treshing operations. When a farmer owns less bullocks, or no bullocks at all, it becomes problematic for him to prepare his fields in time for the rains, especially for the farmers who do not have bullocks. The bullock-owners first use the available traction themselves before hiring them to others. The number of bullocks not only decreased because of fodder-shortage. Other factors were probably more influential: e.g. the split-up of joint families. For the smaller families it is no longer economically feasible to keep bullocks.

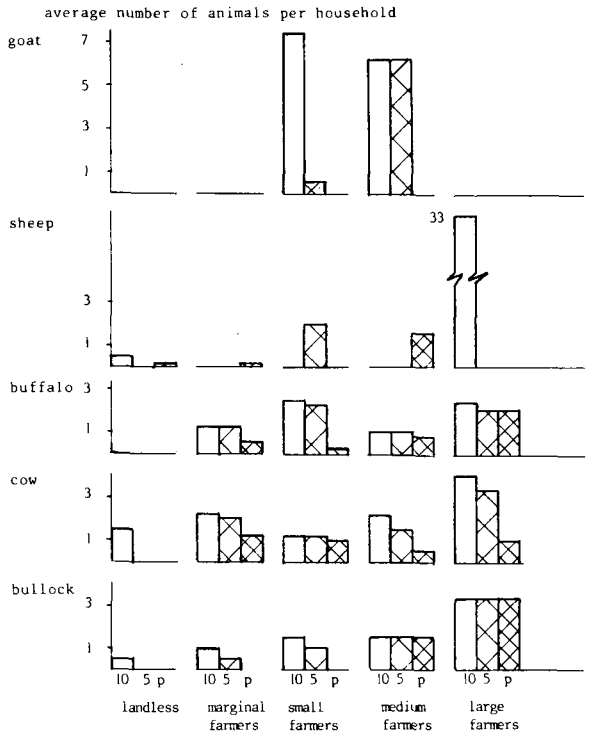
Meat, other products

Reduction of meat-production or of other products has its impact on the total cash income. However not very often cattle is kept for this reason. Not much meat is eaten in the hindu villages, especially no cows, only pigs, sheep and goats.

7.5.6 Social consequences of fodder shortage

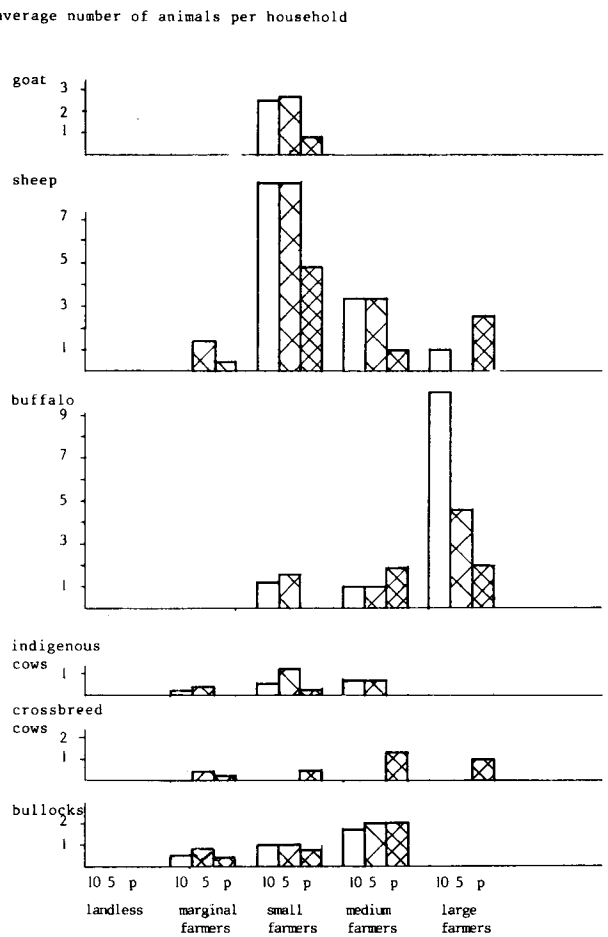
The reduction of cattle-ownership, which is partly caused by the growing fodder shortage (causes fig. 7.20), is not spread equally over all household-categories, as fig. 7.23 and 7.24, giving the percentage of families in Gatlagollahalli and in Kanithalli owning cattle, per household category, illustrates.

Fig. 7.23 Average number of bullocks, cows, buffalo, sheep, goats per household in Gatlagollahalli present (p), 5 years back (5), and 10 years back (10).



Source: fieldwork, 1987

Fig. 7.24 Average number of bullocks, cows, buffalo, sheep, goats per household in Kanithalli present (p), 5 years back (5), and 10 years back (10).



Source: fieldwork, 1987

Figure 7.24 shows that 10 years back it was possible for landless labourers in Gatlagollahalli to keep livestock, even milk cows, without owning land. A landless labourer owning cattle could depend on the common property resources. Thus, in earlier years either the commonly owned fodder resources must have supplied sufficient fodder, or else the access of the landless households to privately owned fodder sources (for instance the fields of employers) was much better.
Sheep and goats can be kept on the public fodder resources by almost all households, providing they have enough labour-force (i.e. women and children) at their disposal, enough cash or loans to invest, and willing to take the risk of investing time, energy, and money. People have not forgotten how a few years back all over the semi-arid region sheep died because of some illness...

In all aspects landless labourers and smaller farmers are less able to find alternatives for the fodder shortage. Also the consequences of a reduction of livestock are much harder to tackle. Most alternatives need cash e.g. small farmers need manure to keep their lands fertile. They are not in a position to spend cash on fertilizers. only at the cost of the already meagre family budget. An other example is milk: for all landowning categories milk is a source of cash, but for this group it is a large percentage of their total income. A reduction means a heavy burden on the familybudget.

In Kanithalli the situation is different, to some extent. Here, not a single landless labourers household owns cattle. It does not seem profitable for them to keep cattle. Is their labour of better use somewhere else, or are the public fodder sources to which they have access not sufficient? Probably both factors play a role.

For the other landholding categories also other developments beside the fodder problem took place. The number of milk cattle increased, mostly as a consequence of the Government program: crossbreed cows were supplied on a loan-basis to every family willing to participate in the program. The landless were also involved (in total 30 cows were supplied to them), but they were not able to repay the loan and in the end they were forced to sell their cow. Due to the low quality of the fodder, the milk-production of the animals was not sufficient for the repayment. Nowadays the category of landless labourers still owns 4 cows.
The possibilities for larger farmers to keep cattle are much better. They have access to private as well as public lands. The larger farmers can solve the problem of labour shortage as well as that of fodder shortage with cash, by purchasing fodder or employing labour to grow it on their irrigated fields. More and more, these farmers prefer a specialized milk-giving herd, without paying much attention to the other qualities of the cows. Their interest in manure and animal traction power is diminishing. This means that the number of bullocks in Kanithalli is even lower than in Gatlagollahalli. Consequently, the cost of renting a bullock rises, resulting in an additional financial burden on the shoulders of the poorer households.

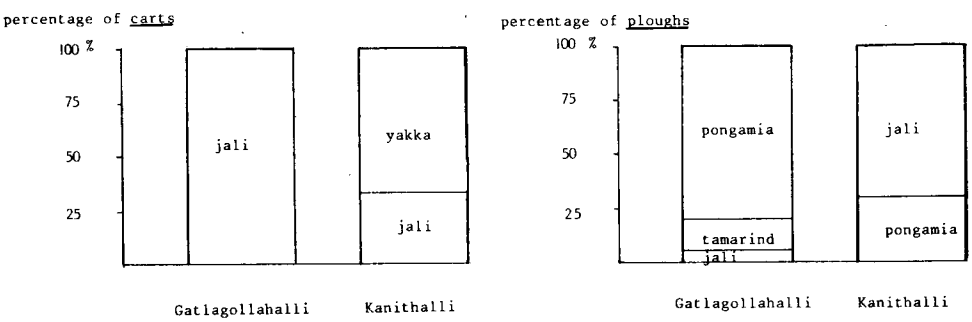
7.6 TIMBER SHORTAGE

Wood serves several other purposes beside fuel and fodder. In both villages wood is required for the fabrication of agricultural implements, house construction, fencing, etc. For most of these purposes the wood needs to be hard and durable.

7.6.1. Timber demand

For the fabrication of **agricultural implements** like ploughs, carts, levellers, thinners and seeddrills, timber is needed.
The replacement-time differs with the implement's use (frequencey of use, quality of the roads for carts, the soiltype for ploughs etc.), the type of wood processed and the availability of wood. Carts have to be replaced about once every ten years, ploughs every year, thinners also once every ten years. Villagers indicated in the questionnaires that they prefer the following species (in descending order of preference): Pongamia, jali, neem, mango, tamarind, jamun. However, they also indicated that each implement has its own optimum type of wood.
In Kanithalli most ploughs[1] are made of jali (fig. 7.25), a hard and durable species, like all Acacia species. Jali is more readily available in Kanithalli than in Gatlagollahalli, where more use is made of Pongamia. This illustrates that farmers link their appreciation of certain species to its availability. Furthermore they link it with other functions of trees. (Mango and tamarind are preferably used as fruitproduces).

Fig. 7.25 Percentage of carts and ploughs made of different tree species in Kanithalli and Gatlagollahalli [2]



Source: fieldwork, 1987

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[1] Most larger farmers use two ploughs, a small and a bigger one, often made of different wood species. Small ploughs are especially used for paddy fields and between the first and second time of ploughing small ploughs are replaces by bigger ones.

[2] The headman of Gatlagollahalli village indicated that for a plough ca. 0.05 m^3, and for a cart on an average 0.5 m^3 is needed.

Furthermore, wood is used as **building material for the construction of houses**. For this purpose, for which durable wood is needed as well, the preference for certain tree-species did not differ much from the species preferred for agricultural implements. (Jackfruit, neem and mango are popular species.) Pongamia is an exception, as this species although useful for the construction of ploughs, is too soft to use for building purposes.

7.6.2 Timber supply

The tree species that could be used for agricultural implements in **Gatlagollahalli** are mostly grown on the drylands (Pongamia) (see 7.2). Pongamias are also kept on the bunds of the wetlands. Although not planted exclusively as timber sources, they provide valuable wood. Whole trees are only sold or used as timber trees if families are somehow in financial trouble, not as a regular income-generating source.
Public sources are roadsides, forest and tankbed. In practice most trees along the roadside are implicitly allocated to the farmers of the adjacent fields. In the tankbed jali trees have been planted recently by the Forestry Department. Although the tankbed is common-property land, the mature trees are property of the Forestry Department according to their regulations. However the trees are often secretly used as fuelwood, not as timber (for this the trees are still too small).
Elderly people in Gatlagollahalli remembered that the forest yielded good quality timber species, such as teak, sal, rosewood, acacias and bamboo (not a tree but eventhough a good timber) some ten to twenty years ago. Mr. Rao explained that outside demands depleted a large part of the stock. Most of the teak was cut by the British, whereas rosewood, bamboo, etc. went to the industries, or were cut to satisfy other urban demands. Nowadays hardly any timber species are available. Only Pogamia is, among other functions, valuable as timber (see 7.2).

Most of the trees used in **Kanithalli** do not grow in the forest or along the road and thus their wood is not freely available (see 7.3). The elderly in Kanithalli can hardly remember whether any teak, sal, rosewood, acacias, or bamboo grew in the surroundings. Demands have been met from other areas through purchase on the market. Also in the private fields, only a few valuable timber species (jali) can be found, but less than on the private property in Gatlagollahalli (see Fig. ..: ownership of trees)

7.6.3 Timber shortage

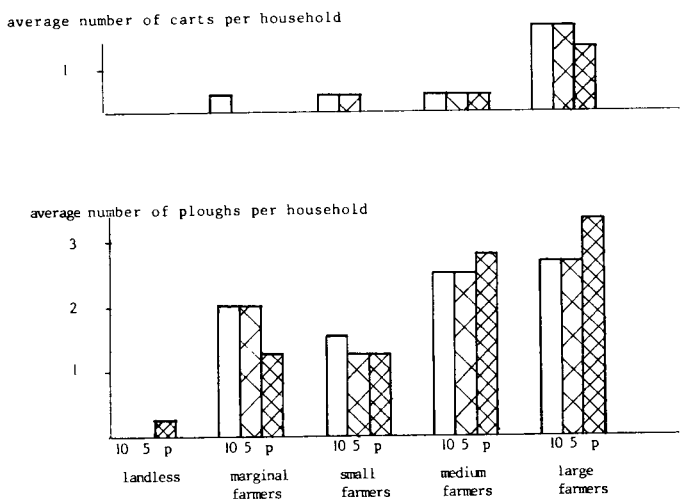
The supply of timber from public and private sources diminished significantly over the past years (see 7.2 and 7.3). The depletion of the public sources caused an increase of the pressure on private sources.

However farmers in Gatlagollahalli as well as in Kanithalli reported that they bought timber in the nearby town. Most private trees have other important functions. Trees are never cut exclusively for agricultural implements.

Nowadays it seems to happen more often in Gatlagollahalli that timber trees are cut and used or sold when farmers face financial problems.[3] Reasons are repayment of loans, marriage, funerals, etc. (see: Fig. 7.20 the selling of animals). The financially most attractive trees are the hardwoord species, of course.

In fig. 7.26 we can see a decrease in agricultural implements in both Gatlagollahalli and Kanithalli. Investigations lead to the conclusion that wood scarcity is not the immediate cause of this trend. In open interviews most farmers related selling of carts to the splitting up of family properties. To use a cart a pair of bullocks is necessary. With less land this is not economically feasible.

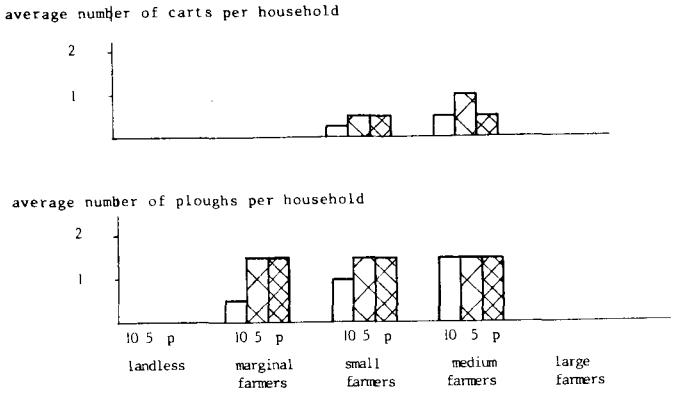
Fig. 7.26 Average number of carts and ploughs per household per category in Gatlagollahalli at present (p), 5 years back (5), and 10 years back (10).



Source: fieldwork, 1987

[3] A medium farmer from Gatlagollahalli told us that when he needed wood for the construction of his new house, he decided to cut a jackfruit tree on his own field instead of buying the wood. He preferred to save the money for other purposes, like dowries for his daughters when they would get married.

Fig. 7.27 Average number of carts and ploughs per household per category in Kanithalli at present (p), 5 years back (5), and 10 years back (10).



Source: fieldwork, 1987

Although we expected changes in the species used as timber over the years due to changes in availability, prices, etc., in particular as a consequence of the trend towards buying timber instead of cutting own trees, these changes could not be concluded from the information supplied to us by our respondents. This does not mean that these changes did not take place -only, that we lack sufficient data to prove them. We did not specifically ask about this matter.

The impact of the use of timber on the timber-supplying sources (like the forest) is difficult to assess as timber is not used daily in regular quantities, like firewood. Over time, the number of trees decreased less as a consequence of local timber-demand (though such demand increased due to population growth) than as a result of external industrial demand (e.g. all sandalwood trees were felled for commercial purposes). Thus a more integrated approach towards causes for shortage of any biomass product is necessary (see 7.9).

7.6.4 Social consequences of the timber shortage

Attention should be paid to the total decline of the living standard, forcing households to sell goods like bullock carts first. From fig.7.26 and fig. 7.27 we can see that smaller farmers do not own a bullock cart anymore (expenses about 800 Rs). Smaller farmers are for this reason forced to hire equipment which is another burden on their familybudget. Furthermore due to high (urban) demands prices of timber are going up. Timber is becoming a commercial item, also for the poorer households. Already in the previous chapter on foddershortage has been pointed out that without plough and bullocks the farmers' risk increases: for them the time of ploughing depends on the avaibility of bullocks not only on the weather, which increases the risk of yield failure.

On the other hand the more land a farmer owns the higher his need for timber (in contrast to fodder). He needs more fencing, more agricultural implements, construction-wood for cattle sheds, etc. Although this is even for large farmers a "new" burden on their budget they have enough financial backing to withstand this problem.

In Kanithalli - the more prosperous village - large farmers own a tractor and are not in need of timber for ploughs and carts. Medium farmers are also able to purchase iron ploughs, which are more durable (but according to Gatlagollahalli-villagers, iron ploughs are less suited for ploughing than wooden ploughs). Replacement is not needed as often. Therefore the need for timber is less (the handles of iron ploughs are still made of wood).

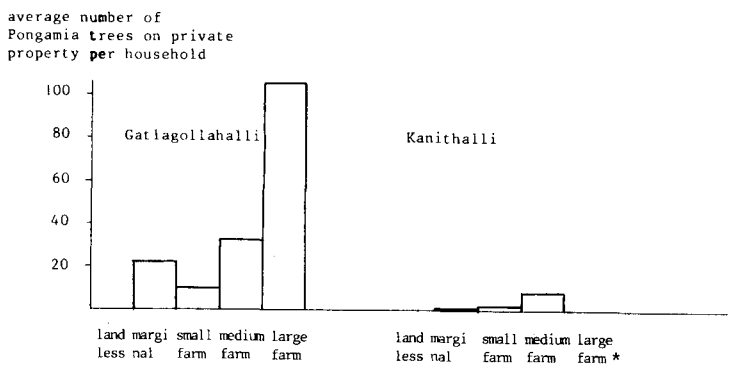
7.7 GREEN MANURE SHORTAGE

7.7.1 Causes and consequences of green manure shortage

Villagers of Kanithalli and Gatlagollahalli consider green manure a useful additional fertilizer. In both villages leaves and flowers of trees are used to add organic matter to the soil, which improves the structure of the soil, influencing among other positively the water table.
Farmers use green manure from the following trees (in descending order of preference): *Pongamia, neem, simetangedi, yeka, jamun.*
The manurial value of Pongamia is among the highest. It is a leguminous species: through the fixation of atmospheric nitrogen by root nodules its leaves have a high nitrogen content which is thus added to the soil. Furthermore the socalled C/N ratio of leguminous species, with high nitrogen content, is favourable for the number of microorganisms in the top soil.
Nevertheless, *Pongamia* leaves are cut for manurial purposes only once in two years to enable the tree to recover (necessary as the tree also has other functions: it is a source of fuelwood, timber for the construction of ploughs, fruits, it provides shade, ect.). Of course flowers that drop yearly on the ground are applied directly to the paddy fields.
In Gatlagollahalli Pongamia trees often line the roads; the farmers with fields nearest to the trees have a right to their resources. Pongamia trees can also be found on the bunds of the paddyfields. These are most in need of this organic fertilizer that improves the structure of the soil.

Fig. 7.28 shows that the number of Pongamia trees is much higher in Gatlagollahalli than in Kanithalli. Mostly farmers in Gatlagollahalli reported the importance of green manure from Pongamia. This can be easily understood if taken into consideration the lack of attention given to paddy field in Kanithalli. Hardly any paddy has been grown in the last few years.

Fig. 7.28 Average number of Pongamia trees on private property per household in Gatlagollahalli and Kanithalli.



* no data

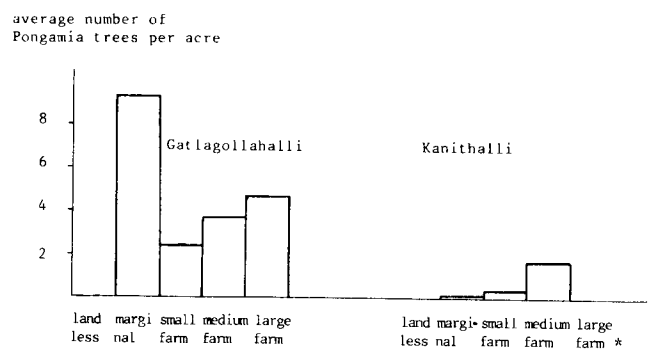
Source: Village Accountant

Green manure can either be applied directly to the fields, or used indirectly by adding leaves (and branches) to the compost pit.
With the increasing demand for organic manure due to a decrease in livestock, change in cropping pattern[1] and increase in agricultural fields, the pressure on the trees rises inevitably. The prunings are becoming heavier and more frequent.

7.7.2 Social consequences of a green manure shortage

In this part we will concentrate on Gatlagollahalli-villagers. For them green manure is more important as we saw.
Trees with manurial value are of course only of interest for landowners. The availability of green manure for each category of landholders differs with acces to the sources. In fig. 7.29 is illustrated that the number of Pongamia tree in individual property increases with the landownership, even if we compare the number of trees per acre. The high number of Pongamia trees of marginal farmers in Gatlagollahalli can be decleared by one respondent having a large acreage of wasteland with Pongamia trees adjacent to his fields.
From fig 7.29 it will be clear that smaller farmers have less green manure per acre available. Larger farmers have spare land for growing this kind of non-staple foodcrops.
Green manure was and to some extend still is a freely available item, improving the structure of the soil and for which only labour is necessary. The overall decrease in numbers of trees, decreases the amount of green manure, thereby increasing the dependency on other organic fertilizers. If no substitute is applied, the structure of the ground will deteriorate, causing higher risks for erosion and a decrease in yield, especially for the smaller farmers.

Fig. 7.29 Average number of Pongamia trees per acre and per household-category in Gatlagollahalli and Kanithalli.



* no data

Source: Village Accountant

[1] Grapes need a considerable amount of organic fertilizer, beside chemical fertilizers.

7.8 MINOR TREE PRODUCTS

7.8.1. Minor tree products in Gatlagollahalli and Kanithalli

Many other forest products exist which are gathered by local people to use at home.
In Gatlagollahalli villagers collect different products from the forest: herbs, medicinal herbs, flowers and fruits: e.g. the black edible berries from nerili trees (Eugenia jambolana, myrtaceae). Furthermore, various articles are made out of products from the forest. Neem trees (Azadirachta indica, meliaceae) provide seeds that people press out to obtain oil. The twigs of neem are used to brush teeth. The leaves of muthuga (Butea monosperma, papilionaceae) are stitched together to form disposable plates for festive occasions; Leaves of the tupra-tree (Diospyros melanoxylon, Ebenaceae) are used for making cigarettes. Agave (sisal) and coconut, among others, supply the raw material for the fabrication of various types of ropes. Leaves of coconut are also used to weave mats, for roof-tatching, etc (see appendix). Some of these products are sold on the market mostly by poorer families.

Totha Siddhappa ('Garden Siddhappa'), the local medicine man, collects his herbs from spots at distances of up to ten kilometers from the village. He also grows herbs in his gardenland. Siddhappa although already very old, is the only person in Gatlagollahalli familiar with the medicinal plants.

In the few conversations we had in Kanithalli about this subject hardly any of such products were mentioned. We already mentioned that the Kanithalli-forest is not as diversified as the Siddherabata-forest near Gatlagollahalli nor was it that recently exhausted. Consequently it does not yield as many different products for household use as before.

As will be clear form 7.2 and 7.3 the availability of most of these forest products has deminished due to deforestation. E.g. a decrease in the number of Pongamia automatically decreases possibilities to extract oil out of the seeds, to use for lighting. It increases the dependence of rural people on kerosine for lighting. It forces them to switch from a renewable local source to a non-renewable imported source to satisfy a basic need.

The inability to obtain these minor tree products causes the inequality among the villagers to grow still larger, because the disposal over cash enables the larger farmers to buy these products. Consequently the quality of smaller farmers' livelihood deteriorates.

7.8.2 Bamboo: a minor forest product

In the common property area, also bamboo (Dendrocalamus spec., Graminaea) has become scarce. The area no longer provides sufficient quantities for basketmakers who rely completely on the bamboo-supply.
With the gradual decline in bamboo trees all basketmakers of Gatlagollahalli have been forced to adopt other professions. Nowadays a nomadic basketmaker and his family visit Gatlagollahalli once in a while. They stay until the small stock of bamboo the villagers built up in their absence is exhausted. A few landowners keep a bamboo-bush on their

private property. They generally prefer to sell its yield completely, usually not to a basketmaker, as these craftsmen cannot afford such large investments, but to small industries.
Beside these private sources, a basketmaker family can also collect bamboo from the (government-owned) reserved forest. The bamboo is free, but to gain access to the forest a household needs a license, which - including the inevitable bribes to obtain it - costs more than when the family buys the bamboo it needs on the private 'market'.
Thus nowadays basketmakers have to invest in a formerly free and abundantly available tree product. Under these circumstances even the itinerant basketmakers can hardly earn a living for themselves and their families. According to the basketmaker that visits Gatlagollahalli he even lacked the money to pay a doctor when two of his children were sick (and died).

At the same time the demand for bamboo baskets has increased as a result of the introduction of mulberry, as big plate-like baskets are particularly appropriate for the culture of silk worms. Bamboo can be plaited to produce the coarse meshes necessary to house the pupa without much effort. It is light-weight, easy to handle, and relatively cheap compared to other materials like the bush Lantana camara.

In Kanithalli no bamboo is available. Basketmakers use twigs of the Lantana camara-bush. Their baskets are used for the transport of sand or compost, but are not suitable to breed silkworms. Kanithalli-silkworm breeders therefore have to purchase their baskets on the Chickballapur market.

Neither in Gatlagollahalli nor in Kanithalli bamboo has been replanted The government does not feel itself responsible for a sufficient bamboo supply. In the forest, bamboo has nearly been depleted, mainly due to excessive exploitation for paper mills. Now papermills are forced to import raw material from Andra Pradesh (Gurha, 1983 : 1896)

7.9 DETERIOTATION OF BIOMASSRESOURCES

7.9.1 Introduction

In the previous paragraphs we described the loss of several functions (for causes see Ch.7.10) of the environment of Gatlagollahalli and Kanithalli.
To summarize, the decline in tree wealth can take several forms:

1. Physical loss of resources (such as the conversion of grazing land into agricultural land) and level off of productivity as revealed by degradation of forest;
2. Re-assignment of usage and property rights as indicated for instance by the transfer of grazing lands into private ownership.

Adopting this classification here, the aim of this paragraph is to discuss the combined impact of these changes on the functions of the environment of Gatlagollahalli and Kanithalli.

7.9.2 Biomass flow of Gatlagollahalli and Kanithalli

Introduction

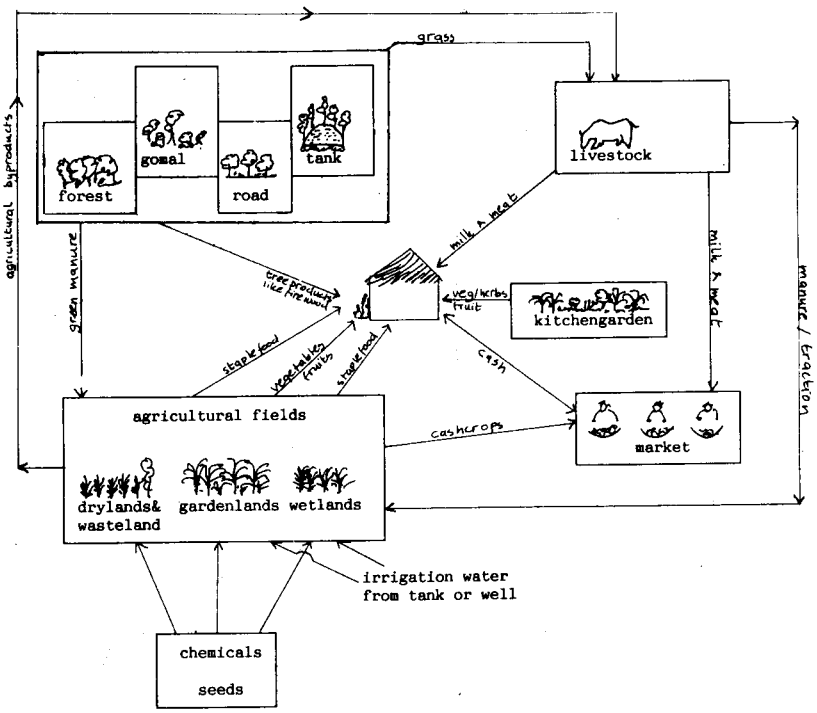
An overview of all biomass inputs and outputs of the different land use types in figure 7.30 illustrates that the production systems (agriculture, livestock, non-agriculture) are strongly interrelated. In the figure an average household is placed in the center (assuming it has access to all resources).

If one understands the existance of linkages as illustrated with this biomass flow pattern, this will be the key to understanding the effects of all different demands - like fodder, fuel, and timber - on one resource. Moreover the figure can easily illustrate the effects of the planning strategies of government programs and industrial interference. For instance with the biomass flow in mind it is an illusion to think that the fuelwood problem can be conquered in isolation from other problems related to land use.

A short description of the biomass-flow pattern is given below:

The vegetation formed by photosynthesis (for instance in forests) forms a nutrient- and energy flow through the livestock system. A build-up of the compost pit with cattle manure supplies the organic matter required for the maintainance of the fertility of the agricultural fields. A portion of this nutrient flow, supplemented again by photosynthesis production, returns to support the livestock in the form of fodder from agricultural by-products. Of course losses through metabolism, leaching of nutrients and a variety of other pathways occur at most points in the system, which makes the system (defined as one village and the surroundings it is using) never completely closed.

Fig. 7.30 General biomassflow of the landuse system under study



Source: fieldwork, 1987

Biomass flow in Gatlagollahalli

Given its primary focus on staple food agriculture, supply of other basic needs from common property resources and animal husbandry, Gatlagollahalli can be considered as an example of the biomass flow outlined above. For analytical purposes its biomass system is depicted as closed. This assumption is justified by the current low levels of food in- and export, chemical fertilizer usage, and migration.

As everywhere the limiting factors are of utmost importance for the whole biomass flow system. As has been described in the paragraph on fuel and fodder, especially the deminishing common property resources and the decline in their condition has its impact on the quality of all other sources. E.g. the supply of products from the common property resources in the above left corner influences the quality of the agricultural fields, as illustrated in fig. 7.30.

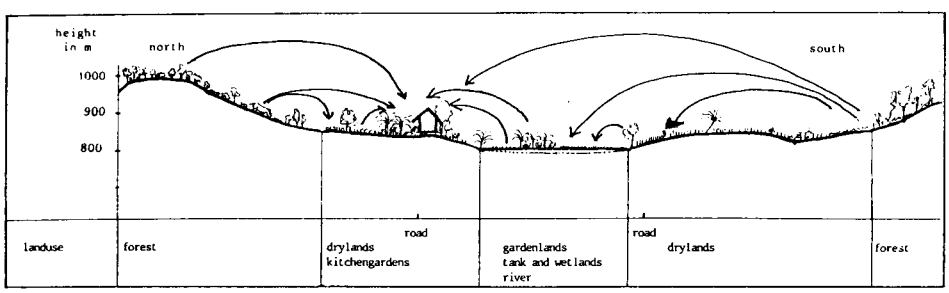
Biomass flow in Kanithalli

In Kanithalli the situation differs more from the basic pattern outlined above (fig. 7.30). Here the village resource utilization pattern can only be clearly described if outside pressures are included in the analysis. These commercial pressures obscure the influence of utilization patterns by the villagers on the biomass resource base.
In Kanithallli the total biomass flow is concentrated in the valley. Products from the hills (drylands and forests) are mostly used for outside demands (eucalyptus plantations on private and government-owned areas) in contrast with what happens in Gatlagollahalli.
Kanithalli is more or less oriented on cash crop-cultivation, at least as far as the larger farmers are concerned. Keeping milkcattle is becoming a specialized enterprise for them. Therefore they will have to make more land available for livestock fodder production and use more chemical inputs. This results in a concentration of attention for lands on the better soils, particularly irrigated areas. Marginal lands are left untouched and unattended.
But even the smaller farmers become more and more involved in cash farming. Sericulture becomes a family-based household industry for which only half-an-acre of irrigated land is sufficient and a very small starting capital suffices. Sericulture is a labour-intensive farm activity, combining intensive land cultivation with intensive silkworm rearing in the household.

Changes in biomass flow in the watershed

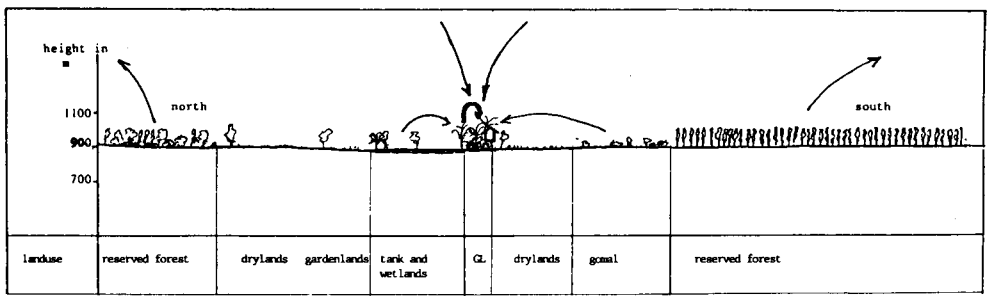
If we draw a cross-section through the landscape of Gatlagollahalli, a diagram appears, illustrating how the biomass flows are spatially arranged (the flows are indicated by arrows).

Fig. 7.31 Cross-section through the watershed of Gatlagollahalli with arrows indicating the biomassflowpattern



As has been described in Ch. 7.2, the area of common property resources in Gatlagollahalli diminished and its condition declined (common property resources are accessible to the whole community of a village; no individual has exclusive rights to them (Jodha, 1986)). Through comparisation of the arrows of ten years back with the ones indicating the present-day situation in Gatlagollahalli (fig. 7.31), the following major changes over the period can be signalled:
Whereas forest products formerly supported the agricultural fields downhill, these areas (now themselves converted to agricultural fields) need inputs from (downhill) livestock, or from outside.
A similar sketch can be made for Kanithalli (fig. 7.32). The biomass flow concentrates in the valley, whereas the hills with their eucalyptus serve outside demands.

Fig. 7.32 Cross-section through the watershed of Kanithalli with arrows indicating the biomass-flow-pattern



*please note that the figures/trees are not on scale.

7.9.3 The biomass flow of the poor

The contribution of the communally- and government-owned sources to the total biomass supply is of importance, notably for the landless and marginal farmers as these are the only natural sources for their basic needs-satisfaction beside their income. In fig. 7.33 an example of changes in ownership-rights illustrates the change in biomass flow for the poor. Forest (a formerly communally or publicly owned source to which they had access) is converted into privately-owned agricultural fields. This limits especially for them, the access to fuel, fodder medicinal herbs, timber etc.

The government's intention of the privatization of forest/gomal was to give land to poor households, being landless or with very little land. In Gatlagollahalli a whole community of landless (Scheduled castes!) were settled at once in the catchment area and former forest. This seems to be an exception. A closer look after 10 years shows us that only one household profitted from this 'gift', and now owns almost all previously given-out land. All other households are (almost) landless again.

The often low quality of these lands was a sometimes impossible treshold. A huge investment is required to cultivate these encroached lands properly. The encroached and therefore uncertain status of the land did not stimulate to invest labour (and capital). And of course most of these households did not have access to capital. Necessary inputs like ploughs or seeds, were only later included in the program. At the same time the necessary labour that had to be invested could be used more profitably and with a higher security if hired out to other (richer) farmers.
From another study (Jodha, 1986) it is evident that although privatization was promoted in the name of helping the poor, very little land was received by them.

As can be seen in fig. 7.33 and 7.34 not all landless in Kanithalli and Gatlagollahalli gained from possessing more private land.
Thus transfer of forest/gomal lands has not helped the poor to improve their resource position in relation to the better-endowed farmers.
Moreover poor were deprived of their rights of collective use. It is quite clear that agricultural land cannot supply all basic needs when it is only small and just able to supply staple crops.

Fig. 7.33 Change in landownership of households due to encroachment in Gatlagollahalli.

Gatlagollahalli

present household category	household category before encroachment	acres encroached	year	status
landless*	landless	2	1984	encroached
landless*	landless	1	1984	encroached
marginal farmer	marginal farmer	1	1973	encroached
marginal farmer	marginal farmer	1.20	1985	encroached
small farmer	landless	4	1957	approved

* Only after deviding households into categories, we found out landless (unlegally) cultivated lands.

Fig. 7.34 Change in landownership of households due to encroachment in Kanithalli.

Kanithalli

present household category	household category befor encroachment	acres encroached	year	status
marginal farmer	marginal farmer	1	1967	approved
marginal farmer	landless	3	1975	approved
small farmer	marginal farmer	3	1967	approved
small farmer	landless	1 + 3	1967+'75	approved
small farmer	marginal farmer	3	1965	?
small farmer	marginal farmer	1	1957	approved
small farmer	small farmer	2	1969	approved
medium farmer	small farmer	2.5	1977	approved

Source: fieldwork 1987

The privatization of the forest is not a positive development if we take the above mentioned facts into account.
Although the sample is based on a small number of households, some indication can be given of effects of the changes in productivity of all land use types if we look at the acreage of privatly owned agricultural land. Fig. 7.35 shows that marginal farmers of Gatlagollahalli own at present less land compared to 10 years back (especially high productive wetland and gardenland) This is also the case for small farmers. Medium and large farmers were able to enlarge their acreage of wetlands.
In Kanithalli (fig. 7.36) the situation has not changed much in the last 10 years with regard to wetlands and gardenlands. Only large farmers were able to improve their cashcrop production by converting drylands into gardenlands.

Fig. 7.35 Average acreage of wetland (WL), dryland (DL) and gardenland (GL), 10 years back (10), 5 years back (5) and at present (p) of each landholding category in Gatlagollahalli.

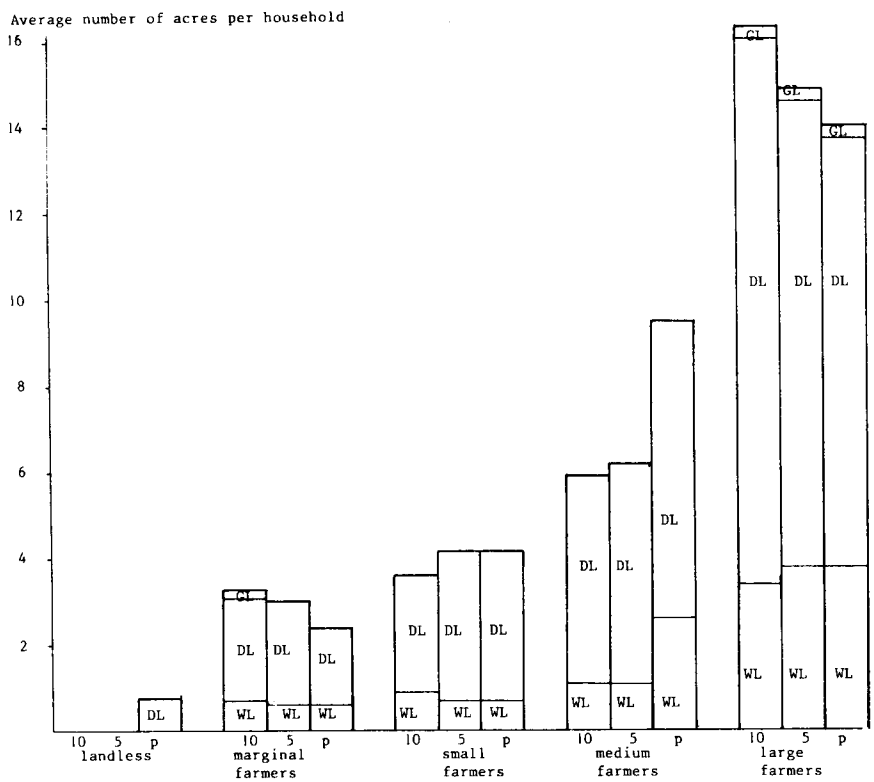
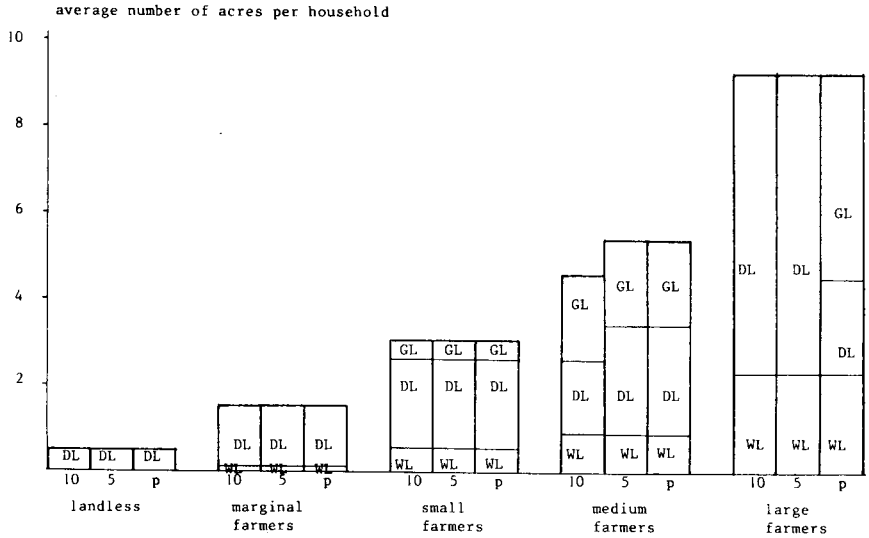


Fig. 7.36 Average acreage of wetland (WL), dryland (DL) and gardenland (GL), 10 years back (10), 5 years back (5) and at present (p) of each landholding category in Kanithalli.



Source: fieldwork 1987

Alternative strategies

The poor have little or no realistic alternative to what they are doing within the existing social and political power structure. Marginalization of the poor is illustrated by the examples fuel, fodder. The inability to obtain adequate goods from the surroundings to fullfill basic needs (and a few (luxury) items, for instance fruits, herbs to flavor meals, oil) leads to a lowering of the quality of life. In Gatlagollahalli the quality of life even further constrains because basic needs become still scarcer, costlier, and harder to reach.
The sequence in which goods are sold indicate their importance and at the same time the severity of the situation. Selling of jewellery often is a good indicator of a severe situation. The jewellery of the women is given from mother to daughter from generations on (oral information Reddy).
In both villages the following sequence in selling goods could be seen

1. cattle
2. trees
3. land (see fig. 7.37 reasons for selling of land)
4. jewellery of women.

Fig. 7.37 Reasons for selling land

Gatlagollahalli

household category	land	reason	otherland
marginal	dryland	no bullocks, cannot manage	yes
marginal	wetland	expenditure marriage daughter	yes
marginal	gardenland	loan amount	yes
small	wetland	buy other land	yes

Kanithalli

household category	land	reason	other land
marginal	wetland	marriage	yes
small	wetland	marriage	yes

7.9.3 Attitude towards trees

If we take a closer look at trees and crops, we can observe that preference is given by farmers from Gatlagollahalli to crops compared to products of trees. In a few cases trees were cut as they caused shade to the crops. Their continuous provision of fuel and fodder were not as important as the production of agricultural crops. An exception in Gatlagollahalli is the tamarind tree. Its fruits are highly appreciated and prices on the markets are quite good (in comparison for instance to the income from ragi). Not only tamarind, also other fruit trees are preferred because of their possible cash income.
At some places in Gatlagollahalli a dilemma is developing between basic food security and cash-crop cultivation. In Kanithalli the choice is made for cash crops.

7.10 THE ADMINISTRATIVE CONTEXT OF FORESTRY PROBLEMS

7.10.1 Introduction

Till the 1930-ths Gatlagolahalli and many other villages in the Deccan were enclosed by dense natural forest.
The natural forests got totally depleted without reafforestation taking place. The reasons are given in Ch. 7.
Another development was that villagers more and more started cutting trees on communal and private lands. A trend which can be partly explained by the degradation of the natural forest which forced villagers to fall back on tree resources on their own lands in order to satisfy their demand for fuel, timber etc.
However, a trend which started only 2 decades ago, and which is even more worrying, is that a declining portion of villagers undertake planting of new trees on village lands and private holdings.

To understand the changes in treecover (and in this respect the attitude of the villagers and the government agencies) insight is required in the tenurial system, in the legislation and in the social setting (see Ch.5).
The tenurial-legislative system provides the villager with formal guidelines and restrictions.
First, the tenurial system determines how ownership- and userrights on land and trees are organised.
Second, legislation should specify by which criteria and under which circumstances persons or institutions, private or public, have rights and obligations with regard to tree-growing (see Ch. 5).
Questions have to be answered such as: is the land private or publicly owned? If the latter is the case, does this department allow villagers access to the land and the use of the produce of trees? Who protects the trees and who is responsible for the planting of new trees?

7.10.2 Landtenure and tree-growing

As already said, the tenural system provides the framework for the villager's rights and sense of responsibility for the land. Unclarity and uncertainty about land tenure forms a fundamental barrier to treeplanting, as people without a secure title to land are reluctant to make the long term investments required for tree-growing.
It must be mentioned that the unraveling of the complex of different rights and priveliges over land and trees (and other resources such as water) is a complicated affair. Government officials, such as the Tahsildar (see Ch. 5) or other, lower ranking, Revenue officers were often ignorant about these matters. (We experienced that the ex-village officials, notably the Shanboque, were most competent to give detailed information).
The ignorance among government officials contributes to the general vagueness as regards rights over trees. This in combination with the fact that the authorities have made some very arbitrary manouvres in this field in the past (see next Ch.) make these government agencies in the eyes of most villagers unreliable partners to deal with.

Landownership in the rural areas falls apart in private landholdings and Government lands. In the area surrounding Gatlagollahalli, approximately 60 % of the land is in private hands, owned by individuals, joint fami-

Fig. 7.38 Rights and duties of various agencies with regard to different land-use types.

	Owner of Land	Owner of Trees	Beneficiary of Trees	Supervisor	Maintenance
Tankbed/tanktoresnore	Rev. Department	Publ. Work Dept.	Publ. Work Dept. conducts sale of production	Jr. Engineer (Publ. Work Dept.)	Publ. Work Dept.
Tank	Publ. Work Dept.	Publ. Work Dept.	Publ. Work Dept.	Publ. Work Dept.	Publ. Work Dept.
Gomal	Rev. Department	Rev. Department	Rev. Department	Rev. Department	Rev. Department
Reserved Forest	Forest Dept.	Forest Dept.	Forest Dept.	Forest Dept.	Forest Dept.
Village Forest	Mandal Panchayat	Rev. Department	Mandal Panchayat	Secr. of Mandal P.	Mandal Panchayat
C & D Lands	Lands are handed over to Forest Department for re-afforestation				
Roads:					
State & Nature Highway	Publ. Work Dept.	Publ. Work Dept.	Publ. Work Dept.	Jr. Engineer (Publ. Work Dept.)	Publ. Work Dept.
Village & Country Roads	Publ. Work Dept.	Publ. Work Dept.	Publ. Work Dept.	Jr. Engineer (Publ. Work Dept.)	Publ. Work Dept.
Streambed/Embankment	Publ. Work Dept.	Publ. Work Dept.	Publ. Work Dept.	Publ. Work Dept.	Publ. Work Dept.
Gundu Topu	Rev. Department	Rev. Department	Rev. Department	Rev. Inspector	Rev. Department
Imerzie Grounds*	Mandal Panchayat	Mandal Panchayat	Mandal Panchayat	Secr. of Mandal P.	Mandal Panchayat
Sanad**	Rev. Dept./Forest dept. Publ. Work Dept.	Private	Private	Private	Private
Schoolyard	Dept. of Educ.	Dep. of Educ.	School	Members	Members
Burial Grounds	Given by the government to religious communities				
Other village grounds	Rev. Department	Mandal Panchayat	Mandal Panchayat	"village leaders"	Mandal Panchayat

* The yield form these trees, or the wood after trees are felt, are suctioned by the village accountant of by the secretary of the Mandal Panchayat.

** In 1978 all roadside trees were transfered to the Forest Department. People who had a sanod on some of these trees had to go to courb to safeguard their titles to the trees.

lies, temples, etc. What remains is government land. Therefore the Revenue Department claims ca. 50 % under her jurisdiction. The Public Works Department (PWD) controls some small amount of land, mostly occupied by infrastructural works: tankbund, roads etc. The rest of the land falls under supervision of the Forest Department.
Fig. 7.38 gives an overview of the different land-use-types and the rights and duties of various agencies with regard to these lands and trees.
By linking the theoretical 'division of labour', as shown in fig. 7.38 with the actual performance of the (semi-)government agencies we can gain an insight in the causes of the ongoing deforestation and the stagnation of reafforestation/tree-management.
In the following sections an effort will be made in that direction. To that end we will focus primarily on the problem of 'under-management' of lands where, officially, the Revenue Department and/or Forest Department are supposed to contribute to land- and tree-management.

7.10.3 Common property land versus open access land

Traditionally a major part of the Revenue land is used as 'common land'. Wastelands, grazingland and tankbed are among the Government lands where villagers enjoy rights of access for fuel collection and grazing of cattle.
An important distinction, however, should be made. There are what one can call: 'open access lands' and real 'common property lands'(Saxena, 1987: 4).
The latter are lands in which rights are regulated by the community through formal and informal institutions. (The supervisory actions of the former village-officers were a good example of land-management by formal village-level institutions (see Ch. 5). The involvement of templecommittees and youth-clubs in tree-growing form still living examples of informal institutions which preserve village commons).
Open access lands are most often revenue lands which are not managed nor protected by either the Government or the village community. These lands are open to unregulated access by individuals. No user can control the activities of other users, total demand exceeds supply, and there is no organisation to enforce discipline.[1] Unrestricted exploitation results in degradation of the resource. This is the situation we found in Gatlagollahalli and Kanithalli when we examined the lands which are still recorded as 'Gomal'. The land is denuded of tree cover and exposed to heavy erosion. At present neither the villagers nor the authorities invest in these lands. Thus the answer to the question: "what turns land into 'open access land'?", should be searched in the lack of some sort of social or institutionalized force which can commend the villagers to restrain from overexploitation and to invest labour, land, money in the preservation of the commons.
After the abolishment of the old village-officialdom the ex-Shanbogue and ex-Patel withdraw from their supervisory function. Their tasks with respect to the management of the village commons, viz the prevention of the unauthorized cutting of trees, the collection of grazing fees, and such, was not continued by their successor, the Village Accountant.
In no way the Revenue Department has contributed to the introduction of a (new) organisation which could help the villagers in awakening the

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[1] This is what Hardin called, 'the Tragedy of the Common'. (Hardin, 1968: 1243-48).

necessary self-regulatory forces to regenerate and conservate their village-forests.

7.10.4 Legislation and tree-growing

In this section we will deal with problems in forest management which can be attributed to shortcomings in the regulations and the execution thereoff. In summary there are two imperfections to which we will give special attention.
First of all: most of the legislation on forest trees does not specify which institutions should carry what sort of responsibilities in the field of tree-growing in lands other than the Forest Department land.
Secondly, the regulations on the cutting of trees are too complicated, therefore trees are cut without notification.
The general framework for the legal protection of trees one can find in the Karnataka Forest Act and the Karnataka Preservation of trees Act of 1963 (Ch. IV, 7-c)[2]. The later act mentions the Tree Authority as the institution in charge of the protection of trees and the organisation of treeplanting (Ch. IV, 7-c). Further the act prescribes that each locality or land type in the rural areas shall have a minimum of 5 trees per ha. Any person desiring to feel a tree is obliged to obtain previous permission from the Tree Authority.[3]
Even on paper, however, the procedure looks complicated and bureaucratised. E.g.: if a villager wishes to cut a tree, it is unclear who he should approach to obtain permission. For the farmer the Tree Authority remains an abstract entity.
The Karnatake Forest Act also makes some (rather vague) references to the role of Revenue officers. In practice the Village Accountant is the foremost officer whom one can expect to have a function in tree-preservation as he maintains the landrecords which include the registration of trees on private and public lands. Though also the Karnataka Land Revenue Act contains some sections on tree-preservation, we got the impression, however, that both the Village Accountants from Gatlagollahalli and Kanithalli did not know about the existence and the user- or ownership-rights over these trees.
Farmers explained that they will not ask permission to cut a tree on their own land as they do not understand the procedure, and if they seek permission through the Village Accountant they will often have to bribe him to ensure his cooperation or non-interference(!).

According to the law, the Tree Authority has an important task in encouraging tree-growing in non-forest lands:

> "...the organisation of demonstrations and extension services and assisting private and public institutions connected with tree-planting and preservation of trees..." (Karnataka Preservation of Trees Act, 1983).

As regards the potential of the Tree Authority to effectively mobilise the local people to plant trees, the same holds true as what can be said

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[2] The basic filosophy and guidelines are implied in the national Forest Policy and the Indian Forest Act of 1980 (the revised act will be enacted this year).

[3] The Tree Authority is a committee composed of 5 desk-officers: two senior forest officers, two Taluk or District officers and one non-official member.

of the Tree Authority's role in tree-preservation. The lack of a proper network of well instructed field-officials, makes it practically impossible to supervise and encourage the villagers tree-management practices.

The Revenue Act gives some minor regulations on the rights over trees on private and government land. Reference is made to "regulation of supply of firewood and timber for domestic of other purposes" which falls under the supervision of the Deputy Commissioner (a District level magistrate) "or any other such officer"[4]. Thus (again) we see a very vague indication of the Governments's intention to look after the local availability of tree-products.
The Revenue Department claims the ownership over trees on Gomal land, but the department falls short in regulating the villager's access to such trees.
Further the Revenue Act refers to the: "rules and orders... made generally by the State Government to regulate the use of pasturage." However, neither the Revenue Department nor any other institution is actually charged with the enforcement of these regulations.

And then there is the problem that the different Acts do hardly make any cross-references. The general vagueness about the powers of the Mandal Panchayat with regard to the management of the village forest resources forms an example. The legislation on Panchayat Raj (The Karnataka Zilla Parishads, Taluk Panchayat Samithis, Mandal Panchayats and Nyaya Panchayats Act, 1983) invests the Mandal Panchayat with far going responsibilities for the maintenance of community forests (see Ch. 5).

The Karnataka Forest and Preservation of Trees Act (1983) does create a framework for the development of the Mandal Panchayat's role in forestry. Also the Society Forestry Project Implementation Manual (1986) gives detailed information and suggestions to that end. Neither the Revenue Act (which has been revised recently!) nor the Karnataka Zilla Parishads, ..., Mandal Panchayats Act, however, mention these regulations. Now that the Mandal Panchayats become in charge of the village commons (at present the transfer of Gomal land to the Mandal Panchayats has nearly been completed) the lack of proper guidelines and instruments (such as powers to levy fines and fees and to appoint watchmen) makes it impossible for these bodies to fulfill their tasks.

7.10.5 Rights and obligations to trees within the tenural framework

We should distinguish between the right of ownership over trees and the rights to products or proceeds from trees. Further, such rights can be in private or communal hands or claimed as (exclusive) rights by the government. And then, the trees can grow on private land, communal or governmental land. Put together, figure 7.39 relates rights over trees to the tenurial status of the respective landuse types in which the trees are grown.

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[4] The Karnataka land Revenue Act, 1963 Ch XV section 79: "...who can make orders on the exercise of priviliges by villages over trees on village and government land."

Fig. 7.39: Control/Ownership of Land and Tree Resources

Management of Trees and Land Resources		Community	Private	State
	Community	1.	2.	3.
	Private	4.	5.	6.
	State	7.	8.	9.

Forestry Management Strategies	Characteristics
Community or Communal forestry	1. Communal tree growing on community lands. 2. Tree growing on private lands organized by community institutions. 3. Public land allocated for community forestry projects.
Farm forestry	4. Private tree growing on communal lands. 5. Privately managed tree farming, plantings around households. 6. Public land allocation schemes for private tree growing.
Publicly-managed forestry	7. Public plantings on communcal land. 8. Public plantings on private lands. 9. Publicly-managed schemes on public lands.

Source: Wiersum, 1986

In the following matrix the picture of the rights and obligations with respect to trees per Land Use Type is further elaborated.[5]
The involvement of the Revenue Department is described with the help of short case studies.

[5] The idea for this matrix is borrowed from N.C. Saxena, 1983.

Fig.7.40 The rights and obligations of villagers and government institutions with regard to trees in various Land Use Types.

Forest

Villagers	Revenue Department	Forest Department
Present condition: in both villages a low quality Eucalyptus plantation. In the forest near Gatlagolahalli also some small tracts of poenchemia forest.		
Ownership rights/rights of access:		
Villagers are not allowed to enter or make use of the forest. However, villagers, especially the poor, will frequently graze their animals or collect firewood. Occassionally they have to bribe the forest watchman.	These forest lands fall outside the jurisdiction of the revenue Department. In the 1970-s large tracts of forest land were transferred to the Revenue Dept. for the purpose of granting of land to landless and other villagers.	Forest near Gatlagolahalli is Reserved Forest. In Kanithalli the forest has the status of Protected Forest. Forest Department has full rights. The powers are derived from the Indian Forest Act.
Villagers form Gatlagolahalli resent the eucalyptus policy of the Forest Department. It diminishes their grazing opportunities (for ecological characteristics of Eucalyptus see 7 and appendices) and they fear that the Eucalyptus will affect the water-table and fertility of their lands.		Though the law requires the frequent updating of workingplans, the plans for the two respective forest areas our oudate (the workingplan for the Forest Division whereto the Protect Forest near Kanithalli belongs, is drawn in 1959!
In 1983 villagers from Gatlagolahalli and surrounding villagers agigated against the policy by uprooting several acres of Eucalyptus. (organised by the local Farmers Union.	The Tahsildar, the head of the Taluk administration, is responsible for the maintenance of law and order. This followed suit in other areas. Then police intervention took place.	No proper maintenance.
The farmers symbolically planted more appreciated, indigenous, species.	Arrests were made and villagers underwent imprisonement.	The plantations are raised for revenue generation (sales to industrial and urban market: pulp, fibres, poles, and such).

Gomal

Villages	Revenue Department	Forest Department

Present condition: highly degraded, only some thorny scrub and seasonal grasses; in both villages encroachment has taken place, which is partly regularised.

Ownership rights/rights of access:

Grazing and cutting activities are unrestricted.

People do hardly identify themselves (any more) with these lands. In Kanithalli a plantation on the Gomal failed due to absence of people's participation the project which led to uncontrolled overexploitation. (see 7.3 about "open access land").

The current transfer of Gomal to the MANDAL PANCHAYAT creates a new obstacle to villager's participation in development and protection of a communal plantation on the Gomal. Villagers oppose the fact that proceeds from 'their' communal lands will flow to the MANDAL PANCHAYAT. From fear of loosing control over land and trees villagers from Kanithalli and neigbouring village started cutting trees to secure proceeds.

Though the revenue Act refers to ".. rules and orders to regulate the use of pasturage" such rules have not been drawn. Moreover, at present there is no Revenue authority or local institution to enforce such regulations.
The Revenue Department has not felt responsible for the upgrading of the remnants of Gomal land as a mean to basic needs satisfaction.

Gomal land will be handed over to the MANDAL PANCHAYAT; Karnataka Zilla Parishads,..., Mandal Panchayats ...Act, 1983, section 57-b: "to make over to the mandal Panchayats the management of..., pasture land.."

Forest Department undertakes no supervisory action outside the confines of Reserved and Protected Forest.

In Kanithalli the Forest Department raised a 80 acres Eucalyptus plantation on the Gomal. 50 pct. of the revenues would flow to the Village Group Panchayat (predecessor of the MANDAL PANCHAYAT). After the first clearfellings regeneration of the treestock failed due to overloping by the villagers.
The plantation was not aimed to solve pressing scarcity of fuelwood.
The Forest Dept. did not provide enough guidance. In Gatlagolahalli the Forest Dept. is not involved in reafforestation of the Gomal. Though the community could offer good parntership as the villagers still continue a tradition of tree-growin

Tankforeshore

Villagers	Revenue Department	Forest Department
Present condition: The tankforeshore and embankment near Kanithalli are nearly devoid of any treecover. In Gatlagolahalli the site is partly covered with rich treewealth (Poenchemia, Herculus).		
Ownership rights/rights of access:		
16 villagers have planted some 500 trees in the tankforeshore near Gatlagohalkli under the "Sanad System" (see 7) These villagers enjoy full rights over the trees. (the land belongs to the Revenue Department). The right to cut these trees is regulated by the Preservation of Trees Act.	Though the Sanad system seemed to appeal to the villagers, the system stagnated. The Revenue Dept. does not propagate the the system any longer. The system is not abolished but the Revenue Act did not copy the sections which dealt with Tree-Sanad when it replaced the old Mysore Revenue Manual.	No activities.
Treeowners face difficulties with protection of these trees because the trees are located on the other side of the tank, some 1.2 kms from their village. The ex-Patel from the neigbouring village Gatlagolahalli, the person who took the initiatitive to start planting Sanad-trees, approached the Tahsildar to take measures to stop the demolishment of their trees. No Government actions were taken however.	The Revenue Dept. falls short in stimulating villagers to grow trees.	
	Intergovernmental shifts in jurisdiction over lands create much confusion and uncertainty for the villager. As a consequence of such re-arrangements people had to go to court to secure their rights over trees (even with regard to trees which are planted under Sanad) (see also in this matrix under 'roadside trees").	

Tankembankment

Villagers	Revenue Department	Forest Department
Present condition: along the tankbed of the Gatlagolahalli tank there are quiet a few strips with good treegrowth.		
Ownerschip rights/rights of access:		
Most trees have been planted by villagers (predominantly by landowners) who encroached land in the embankment. These farmers claim exclusive rights over these trees. This explains the unhindered growth of the trees. Nonwithstanding the fuelwood scarcity, other people do not dare to cut these trees, they cover greater distances to find alternative sources of fuel. Thus the trees on the embankment are not considered as free goods. A system of unspoken rules and effective social control guarantees the preservation of the trees.	The Revenue Department tolerates the encroachment.	No activities.

Tankbed

Villagers strongly identify with the tank. Apart from irrigation other communal activities are employed, such as the communal cultivation of dahl and the deepening of springcanals in the tankbed (see 9). Near the foreshore the Forest Department planted Jalli trees in the tankbed. Villagers have no rights over the produce of trees.		Forest Department planted Jalli trees as a revenue generating timber species. However, no protection is secured as forest guards rarely visit this area.

Dry lands

Villagers	Revenue Department	Forest Department
Present condition: Most of the old Dry Lands in Gatlagolahalli have good treegrowth. The new Dry Lands on the steeper slopes of the catchment (former forest land or Gomal) often lack treecover. Some farmers however, planted new trees of 'reorganised' the natural scrub (as fences for protection against animals and as a check on erosion from gullies and widening nalas). In Kanithalli most Dry Lands are devoid of treecover. Some farmers, however, planted Eucalyptus.		
Ownership rights/rights of access:		
	The Revenue Department granted most of the land which is made into Dry Land. Also encroached Forest Land is regularised by the revenue Department.	
The owners enjoy full rights over these lands. Harvesting of the trees is subjected to the licence system under the Preservation of Trees Act. In practice, however, unrestricted felling of trees takes place. The sale of timber provides the villager with the often hardly needed cash (to pay the brideprice (dowry) for daughter or sister, to raise money for a well, etc.). If necessary, the Village Accountant will be bribed to secure his non-interference.	The revenue Act prescibes that in case that Government land is granted for private cultivation, the trees should be felled as to recover their value, they are the property of the Government. This regulation comes into conflict with the Tree Preservation Action which prescribes a minimum of 5 trees per ha! (Ch. VII. sect. 75 (3)	Social forestry: see 7.5 No effective control or judicial action against violation of Tree Preservation Act.
Access to trees on Dry lands is restricted to the landowners. They sometimes give their permission to collect fuel or fodder.	The Department levies land-tax and tax on crops.	

7.10.6 The official answer: Social Forestry

In Ch.5 we mentioned the social forestry programme of the Forest Department. This programme is the main official answer of the government to the pressing scarcity of fuel and fodder in the rural areas.
In the following we will elaborate some of our findings with respect to the implementation of this programme. This gives us the opportunity to apply our earlier statements with regard to landtenure, legislation, the social setting and the task-fulfillment by the executive departments (see introduction). To our opinion these four factors, in combination, create the conditions which lead to deforestation or, the lack of re-afforestation.

The Forest Department and objectives of social forestry

In dealing with the problem of tree depletion, the conventional forestry service is severly restricted in their scope for action (Reyntjes, 1988: 12.). Under the present circumstances and due to a shortage of manpower and resources the Forest Department is unable to replant forest on the scale necessary to combat deforestation and to meet the growing demands for tree products.
In this context social forestry offers a new approach. The idea is that the Forest Department assists rural people to plant trees themselves. Thus the costs of reafforestation can be reduced and it allows tree-growing to be extended beyond the bounderies of the official forest reserves. And, more important, it should enable households and communities to decide their own priorities, and grow the types and number of trees they choose in locations they feel are most relevant to their needs (Foley and Barnard, 1984, in: Reyntjes, 1988: 12). In order to achieve efficient management and execution of the Social Forestry project, a seperate wing has been created within the Karnataka Forest Department: the Karnataka Social Forestry Department.
Besides meeting the needs of the rural and semi-urban people for forest products the project is to supply indirect benefits as well, such as: watercatchment preservation, employment-opportunities and possibilities of raising additional income.[6]

Because social forestry is the main tool of the government to solve the problems of tree depletion, insight in the proceeds of the project is important. In the following some general problems will be discussed and illustrated on the basis of short case studies.

The principal purpose of social forestry is to build the institutional capacity of communities, panchayats and individuals so that they could undertake fuel and fodder plantations through self-help schemes. This has hardly happened.[7] Not in Gatlagollahalli or in Kanithalli nor in most other Talkus. Why not?
A second shortcoming of the way in which the programme receives implemen-

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[6] The formulation of targets and strategies has taken place in deliberation with international donor agencies (World Bank-I.D.A. and O.D.A.) which furnish the major capital (see Project Implementation Manual, 1986).

[7] See also Reijntjes, 1988.

tation is that little precaution is taken to secure that also the poor will benefit. In the following these two comments will be elaborated.
First: emphasis on commercial farm forestry pushed aside the objectives of satisfying the most urgent requirements of the villagers, that is: first of all fodder, then fuel and to a lesser extent small timber.
We think that the objective of "additional income generation" and local needs satisfaction are competative aims. As soon as local produce reaches the industrial or urban market, the price mechanism makes that local people can not afford to pay the increasing prices paid by contractors who supply the industry and the urban market. In Kanithalli we observed that farming households who grow eucalyptus on their Dry Lands go to the forest to collect their meagre supply of fuel! Because they want to spare their own tree-crop for sale. Thus it is even more doubtfull whether other villagers like the landless will benefit from such private plantations. That is not to say that the growing of trees for commercial ends is in itself a negative development, but this should not be propagated as (and financed by) Social Forestry. Nor should it lead to the occupation of communal lands, which form an important subsistance resource of the poor.
In comparison to farm forestry, community forestry lags far behind. As far as reafforestation of communal lands has been taken up, the Forest Department made little effort to involve the villagers in the planning of the project. In Kanithalli, in 1980, 80 acres of Gomal land was planted with eucalyptus under the communal forestry scheme. The aim was to grow a treecrop which would generate permanent income out of auctioning the harvest (once in 3 or 4 years). 50 % of the revenues would flow to the Village Group Panchayat (see Ch. 5), the rest would go to the Forest Department to cover investments.
Unfortunately, villagers were not encouraged to participate in the design and management of the plantation. (Villagers were only involved as far as they were emplyed as labourers). The Forest Department could have sought the support of existing institutions in Kanithalli (such as the Ambedkar Ryate Sangha, i.e. the Youth Club - mainly members of the sceduled caste) or re-establish the traditional village forest committe (see Ch 7). Also the Village Group Panchayat was not brought into the management of the scheme.
The lack of community involvement and the department's narrow focus on revenue generation soon showed disastrous. After the first harvest, regeneration of the treecrop stagnated because the poorer villagers started lopping the branches to fulfill their pressing demand for fuelwood. Then also the department lost interest.
Obviously the villagers regarded the plantation as a pure government project. They could not identify themselves with the ratio of it because they did not take part in the formulation and design of the scheme. Nor did the villagers enjoy the benefits of the scheme. The money from the sales of the treeproduce flew directly to the treasury of the abstract Village Group Panchayat.[8]
Especcially the poor villagers were not enough encouraged to restrain themselves. This group, however, suffered most from the shrinkage of the grazing grounds. At least they tried to cut as much firewood as they could get.
Secondly, the Forest Department makes little effort to recognise and reivigorate local tradition of self-sufficiency in treeproduce. Hardly

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[8] At present this will be the Mandal Panchayat.

any use is made of traditional knowledge and preferences, though this is often one of the most effective ways by which the forester can stimulate the villager's co-operation in tree-growing. In Gatlagollahalli and Kanithalli villagers could still sum up a great amount of treespecies and explain for what purpose their products can be used for. Most of these trees, however, disappeared from the village surroundings at least 10 years ago, but villagers still show symphaty for these species.
Thirdly, in contrast with Westoby's pre-condition that: "Foresters... need to know as much about peasants as they do about trees" (Westoby, J.C. 1987: 318), foresters involved in social forestry often lack insight in the villager's real needs, their living conditions and perceptions. The middle cadre of the forest service often shows a lack of motivation and interest when dealing with the social setting of forestry.
When we talked with farmers about treeplanting they often refered to the 'risks' involved. The risk of spending money on sapplings and spending time in watering and protection, when there is a big chance that the tree will die due to failure of the monsoon, brownsing of cattle etc. Moreover, the planting season for both crops and trees lasts only a few weeks. The farmer and landless labourer will choose to spend that critical period planting foodcrops rather than trees.
These are considerations which do not receive enough attention during execution of soical forestry.
Another obstacle which we experienced during disussions in the villages, is the general cynism towards the chances of success of reafforestation. The villagers quickly refer to disunity in the village and emphasize the incapacity of villagers to cooperate; as a farmer lamented: "Even father and son quarrel, how can you expect us to cooperate."
If foresters are unable to recognise and remove these barrier and encourage some sense of responsibility within the community for treemanagement, then "guards nor wire can protect seedlings form grazing,..." (Noronha, 1983). Fourthly, nonwithstanding the general phenomenon that villages lack unity and that the interest of the poor and the better-off clash (see Ch. 5), the Forest Department still thinks in terms of thé village as the most suitable unit of project implementation. As we could see in Kanithalli such undifferentiated approach does neither reach the poor sections nor does it leads to the development of the above mentioned common sense of responsibility.
It should be asked why the department does not choose to concentrate on those groups which are most in need of a additional supply of treeproduce, e.g. landless labourers and marginal farmers who have little or no access to other, non-communal sources.
In Gatlagollahalli and Kanithalli the poor were totally dependent upon scrub, wastematerial and meagre grass resources which can only obtained by walking long distances. Foresters are often reluctant to pay attention to these fuel and fodder sources. Foresters will quickly regard the growing of scrub and grasses as being beneath their dignity (Personal comment by A.K. Bannerjhee, World Bank, august 1987). This is unfortunate: just because these resources have no economic value the poor do not have to compete for them with the, more powerfull, more 'prosporous' villagers and the traders from outside the village.
Foresters also tend to ignore the other possible bio-mass outputs, such as fruit, seeds and grasses. Especially the latter would form a suitable answer to the alarming fodder shortage.

Our third comment relates to the fact the Forest Department is the only implementing agency of social forestry. Through that the programme lacks

the integrated approach towards tree-growing and community development which it may get if other Government agencies and non-governmental organisations are involved.
The Forest Department lacks the tradition and experience with extension of agencies like e.g. the Department of Agriculture or the Department of Animal Husbandery.
Social forestry involves a fundamental change from the classical forestry approach. In classical forestry the foresters have control over the forest. Under social forestry, however, the actual field-management of trees is to be carried out by local people or common institutions. The role of the professional forester becomes one of stimulating and support rather than execution and control (FAO/SIDA, 1983). Nevertheless, social forestry officials are still geared towards a paternalistic and authoritative attitude[9] and lack of contact or even confidence with the villagers.[10]
This brings us to our fourth comment viz. that a long legacy of hostile relations between foresters and villagers must be overcome.
Villagers still identify foresters with the classical forest official whose task it was (and still is as far as reserved forests are concerned!) to control the villager's access to forest and take action against tresspassers. Corruption under forest officers and the Forest Department's Eucalyptus policies (see Ch. 7) add to this antagonism.
In Gatlagollahalli we experienced that the villagers rather distrust the Forest Department. Foresters never visit the village (though they used to do so in the past) and most villagers have no personal contact with them. Villagers reproached the foresters that they allow contractors to carry off illegal truckloads, though the villagers themselves often have to bribe these officials to gain unhindered access to the forest to collect fuel and fodder.
Lack of respect for the foresters often make the villagers unwilling to cooperate, or as one farmer cynically remarked: "When the fence is eating the grass, what can we do?".
Foresters who are actually trying to find land for communal tree-growing are often told by villagers that no land is available, or they are pointed to barren areas where it is difficult to get anything to grow. This will also hamper the enthousiasm of the forester.
Further the villagers resented the Forest Department for planting eucalyptus on the ridges of the catchment (Reserved Forest area). The villagers feared that these plantations would affect the watertable in the agricultural fields. In 1983 these feelings culminated and lead to a mass protestaction by people from Gatlagolahalli and neighbouring villages. The villagers (organised through the local Rayata Sangha (Farmers Union)) uprooted some acres of eucalyptus and planted demonstratively some more appreciated, indigenous, tree species. The action was put to an end by police interference. Through the villagers asked for a dialogue, the Forest Department never responded, the conflict remained unsolved.

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9 This 'mentality' is in many regards the product of the 'socialising' effect of the administrative culture in the Forest Service.

10 We consider the inadequate training of social forestry officials as one of the main causes of this lack of onderstanding. For example: an R.F.O. who joins the Social Forestry wing (K.S.D.F.) receives only one week additional training with regard to the social aspects of social forestry.

Another argument in support of structural involvement of other departments and institutions in Social Forestry is strictly numerical, and this brings us to our fourth comment: the network of fieldstaff for the execution of Social Forestry is too small.
According to the Project Implementation Manual 130 Taluks (all in the Dry zone) with some 20 million people living in 19550 villages, fall under the Karnataka Social Forestry Project. Some 100 R.F.O.'s with approximately 1500 fieldworkers are appointed (most of them only on part time basis) to cover this immense area. We will give an example of this problem of shortage of manpower at fieldlevel. Gatlagollahalli resorts onder the Korategere-Mudegeri Range. This Range, which covers two Taluks - that is ca. 260 villages - is thé most important level for project implementation. However, apart from the Range Forest Officer (R.F.O.), total fieldstaff only number 15 fieldlevel workers: 3 Forest Extention Workers, 2 Foresters and 10 Motivators. The latter group consists of villagers (also women) which are recruited for, part time, extention work. The R.F.O. is supposed to be the keyperson involved in communication with local, voluntary, organisations. This official, however, is too much occupied with routine administrative work than that he can develop a real understanding with the village population. The real fieldworkers, the Motivators and Forest Extention Workers, are faced with the difficult task of convincing and mobilising villagers to join social forestry. This task of 'social engineering' rquires time and puts a heavy test to the personal abilities of these officers.
When we take into consideration the alarming forest depletion in this area and the serious social and economic consequences (see Ch. 7; Ch. 8) we should ask ourselves why Social Forestry is not taken up on a far more larger scale with the support of other departments.[11]
Earlier we mentioned the transfer of forest and grazing land to the Mandal Panchayat. This transfer is based on the agreement that the Forest Department will finance and develop the re-afforestation of their lands, while beyond three years, the maintenance becomes the full responsibility of the Mandal Panchayat.
Now, our fifth comment is that it seems unrealistic to assume that a resource which has been under bureaucratic management for so long, can be properly managed by an institution like the Mandal Panchayat without strenghtening this institution's capacity to that end. When we discussed the future of these plantations with the executing forest officers they showed their pessimism and took the attitude of "after us the deluge".

The next problem which we want to highlight, and that is our sixth comment, is that the transfer of village grounds to the Mandal Panchayat in itself forms an additional barrier to proper management. Nonwithstanding our exposition about the villagers neglect of the 'open-access-lands' (see Ch. 7.10.3) most villagers still consider these lands as village property.
Therefore they resent the current rearrangements and the majority of the

[11] Forestry is so little regarded that in the sixth national 5-year plan (1980-1985) less than rs 7 milliard have been alloted out of a total allocation of nealy 250 milliard for the rural sector (Vohra, 1985: 51). Or, to give an example: the seventh 5-year plan for Karnataka earmarked ca. 22 pct. of the budget for irrrigation against 1 pct. for forest. A striking point is that the revenues earned by the Karnataka State Government from the sale of forest produce is almost double the expenditure incurred on forestry activities (7-th State 5-yearplan; 1985-1990, 211).

villagers rejects the idea of sharing the proceeds of a plantation on their village grounds with the other villages in the Mandal.[12]
Unless the villagers are assured of some direct, exclusive, benefits they will not restrain from plundering the existing treewealth.
This is what happened in a neighbouring village of Kanithalli. There villagers felled, overnight, a 60 acres eucalyptus forest. This plantation, which was raised by joined effort of the villagers was worth an estimated 1.5 lakh (150.000) Rs. Out of fear that the proceeds would be confiscated by the newly established Mandal Panchayat, they choose this way to secure the returns from their plantation. Taking notice of this, one villager of Kannithalli who had planted some four acres of eucalyptus on encroached Gomal land, followed suit.

7.10.7 The micro-plan

That the Forest Department has given such a commercial turn to social forestry has been heavily critisised. Since 1985 however a gradual reorientation took place. The Forest Department started giving more attention to the problem of basic needs.
It started planting mixed species forest on communal lands for the production of fuel and fodder.
In this context the so called 'micro-plan' deserves special attention. This new component of the social forestry strategy, which was introduced in 1987, regards the village as the development unit. The idea is that after consultation with the villagers, an assesment is made of the actual demand for different treeproduce, and that then a plan is drawn. Various sites in and around the village are to be selected for treegrowing purposes (such as: the schoolyard, land among the canalsides and on the bunds of the private lands). It is an integrated approach, aimed at helping the villagers to satisfy their fuel and fodder demands. Approximately 30 % of the total yield should be given, free of costs, to the poor. The local sale of the remaining treeproduce will provide the village with an additional source of income.
It must be said that the manuals and orders, which accompangy the afore mentioned 're-orientation' and the introduction of the microplan, formulate clear guidelines for implementation.
A few remarks must be made with regard to the implemention itself.
In Shambonahalli a village next to Gatlagolahalli such microplan is introduced. Notwithstanding the above mentioned guidelines, the forester's consultation with the villagers fell short of what is required to overcome the reluctance of villagers to join scheme. No insight could have been gained of the needs and vulnerabilities of the different categories of households. To give an example, the Range Forest Officer motivated the choice of the village with the argument that his department wanted the project leaders to select a stable social environment which would favour the villagers' support to the project, so that the plantationworker would have a fairly good chance of success. In his opinion Shambonahalli formed a cohesive community. It is known to us, however, that the village suf-

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[12] The adiminstrative reorganisation in 1986 whereby the Village Group Panchayat got replaced by the Mandal Panchayat (see Ch 5) brought a scaling up. (The Mandal is a composite of ca. 22 villages instead of the 7 or 8 villages which formed the Village Group). Fact is that nowadays the villager has to deal with the interest of inhabitants of villages which he may never have visited before and where he may have no relations or other relations which bound him.

fers from sever faction struggles.[13] (To give an indication: during the Mandal Panchayat elections, in 1987, 16 members of this villages competed for a seat. This is the highest number of competators if we compare this with the situation in the other 21 villages of the Mandal: in Gatlagollahalli, e.g., - which belongs to the same Mandal - only three candidates contested).[14] The few discussions foresters had with some selected villagers, notably with some village leaders, must have given them an incompleet and probably misleading picture of the situation in the village. And again, the plantationworks have been undertaken as a departmental action, instead of a joint effort in which decision-making and planning is shared with the villagers. Obviously, the department still gives priority to natural resource development (reading the numerical target) above human resource management(!), though the latter is a precondition to secure successful forest management.

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[13] With courtesy to Frank Zimmerman, University of Berkeley.

[14] The Bukkapatna Mandal is divided into six constituencies. Shambonahalli constituency consists of Shambonahalli: and two other villages. In this constituency the 16 candidates from Shambonahalli and the 6 candidates of the other two villages compete for 3 seats in the Mandal Panchayat.

8 DROUGHT PROBLEM

8.1 INTRODUCTION

Irrespective of the landuse system, rainfed farming or irrigated agriculture, drought is considered as the main problem of individual farmers in South Karnataka. The uncertainty of rainfall and the availability of water sources like tankwater and groundwater immediately have their impact on the way farmers and governmental institutions manage local natural resources like forest, livestock, agricultural fields, tankwater and groundwater. Consequently the changes in availability and access to water also effect the social-and economic position of farmers as their income out of production will decrease as rains keep away. In times of water scarcity only a certain group of farmers will find possibilities to get access to alternative water sources.

First of all, for the research-area the physical degree of drought will be defined in terms of climatological and hydrological features (see 8.1.1). In 8.2 we argue that drought problems are only caused by rain shortages, but moreover is determined by over- and underexploitation of still available watersources in both drylands and wetlands. Furthermore, in 8.3, the impact of drought on the natural environment will be considered to draw conclusions with regard to the social consequences. These social dimensions of drought problems are described in 8.4 for Gatlagollahalli and in 8.5 for Kanithalli. Finally we will discuss how policymaking, administrative institutions and legislation deal with drought problems (see 8.6).

8.1.1 A climatological definition of drought

Drought is mostly defined from a climatological point of view, for which both the level of annual rainfall and the uncertainty of rainfall are taken into consideration. Tumkur and Kolar districts belong to the same meteorological sub-division, namely South Interior Karnataka, better known as Southern Maidan. Both districts are classified as semi-arid (Krishnan,1969). On behalf of the Drought Prone Area Program, the Second Irrigation Commission (1972) defined Drought Prone Areas as those taluks where the frequency or probability of failure of annual rainfall is more than 25% from the normal rainfall in more than 20% of the observed years. Areas with more than 1000 mm. of annual rainfall are excluded. For Karnataka this classification proved to be of great importance, as the introduction of drought relief programs depends on this classification (see 8.6.3).

With regard to seasons R.S. Deshpande (1987) groups drought into three categories according to its occurencee:

1) late onset of seasonal rain
2) early withdrawl of monsoon
3) long intermediate seasonal dry spells

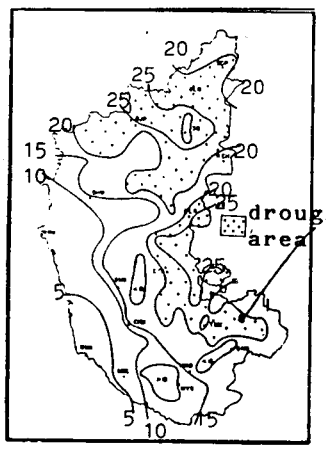
Fig. 8.1 The climatological seasons of South Interior Karnataka

	DRY SEASON		S-W MONSOON	N-E MONSOON
climate	**jan-feb**	**march-may**	**jun-sept**	**oct-dec**
rainfall	little rain	first storms	50-70% of annual rain	30% of annual rain
temperature	cold with min temp in jan	increases to hot in april	decreases	decreases to cold

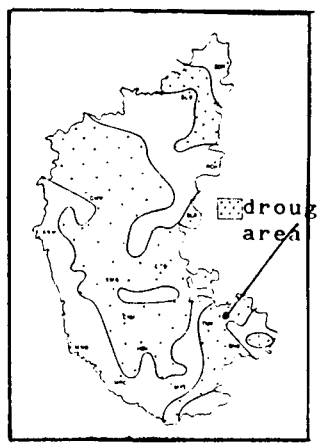
Source: State of the the Environment, Karnataka, 1985

From fig. 8.2 can be seen that a considerable part of Tumkur and Kolar can be defined as drought prone from 1901-1980. Fig 8.3 shows the drought prone areas in 1985.

Fig. 8.2 Percentage of drought years in Karnataka,1901-1980.
Fig. 8.3 Drought areas in Karnataka,1985.



Karnataka State, with Kolar and Tumkur districts indicated



Source: State of the Environment of Karnataka, 1984

As only a certain percentage of the actual rainfall will be used as effective rainfall, due to surface runoff, deep percolation and evaporation, the impact of rainfall to drought can only be studied when the total water balance is taken into consideration. This has to include: precipitation, potential and actual evapotranspiration, water deficiency, water surplus, soilmoisture recharge and soilmoisture utilisation. As specific soil characteristics which determine the soilmoisture storage-capacity can hardly be obtained in the field, we were obliged to concentrate on rainfall and evapotranspiration figures. To give an indica-

tion of a comparable situation the water balance of nearby Bangalore is given in fig. 8.4. It shows a water deficiency from November till July and soilmoisture recharge from July till November.

Fig. 8.4 The annual water balance of Bangalore.

Source: State of the Environment, Karnataka, 1985

8.1.2 Decrease of rainfall

To understand the impact and the management of drought related problems we need to make a closer study of the climatological changes. Looking at fig. 8.2 and fig. 8.3 of the previous paragraph it is seen that the percentage of drought years for Kolar and Tumkur is approximately 20-25% (1901-1980). From 1982-83 the drought situation increased. In the past there have been more spells with deficiency of rainfall (from 1956 recorded): 1965-66, 1967-68, 1972-73 and 1976-77 (Deschpande, 1987). For Gatlagollahalli no reliable data were available, but the situation of Kanithalli shows that the annual rainfall from the period 1979-85 has declined compared to the average in the period 1902-1985 (see fig. 8.5)

Fig. 8.5 Rainfall data for Tumkur and Kolar districts, Gatlagollahalli and Kanithalli.

	mean annual rainfall mm.	C.V.[1] %mm.	S.D.[2]	deficient rainfall once in 5 years mm.
Tumkur and Kolar[3]	700-800	25-30	-	400-500
Gatlagolla halli[4]	618	-	-	-
Kanithalli[5]				
1902-1980	774	27	213	-
1979-1985	655	22	140	-

1) C.V.: Coefficient of Variation = S.D. annual rainfall/mean annual rainfall
2) S.D.: Standard Deviation
3) State of Environment of Karnataka (1984)
4) Unfortunately no reliable data from nearby raingauges were available. A study done by the Univ. of Agricultural Sciences Bangalore gives 618 mm. (no year and recorded years). Depart. of Economics and Statistics Tumkur mentions 658 mm.
5) Data for the years 1902-1980 are recorded at the Siddalagahatta rainguage.
- Not obtained

8.2 OVER- AND UNDEREXPLOITATION OF WATERSOURCES

8.2.1 Introduction

In a semi-arid region the length of a growing season is not only determined by the duration and the distribution of the rainfall, but moreover by the fulfilment of the crop water-requirements from the profile stored water and the collected runoffwater from the catchment. The management of the available amount of water may be of even greater importance than rainfalllevels. Both in drylands and wetlands, the availability of water is determined by the physical conditions of the environment to store and harvest water. As Huibers (1985:27) states, irrigation can secure the wateravailability and as such stabilize and increase the agricultural production in the semi-arid region of South India. In this part of our paper we will accentuate the physical aspects to understand the potential wateravailability in both villages.

8.2.2 Underexploitation of surfacewater

Tankirrigation

In Tumkur and Kolar districts tankirrigation plays a major role in the agricultural system[1]. The principle of tankirrigation is that a valley or depression is closed by an earthen or masonry dam, which creates a reservoir or tank from which the commandarea can be irrigated. The catchment area, the runoffwater contributing area above the tank, is left for its original use like drylands or forest. Excess rain is generally allowed to follow the natural drainage path.

Most tanks in Kolar and Tumkur are fed by the affluents of a small river, the Pennar, or by streams from the hilllocks. A rolling or undulating terrain favours tankconstruction.

Tanksiltation in Gatlagollahalli

The tank of Gatlagollahalli is used by farmers of three different villages: Gatlahalli, Gatlagollahalli and Baraka (see fig 5.1). The commandarea is officially about 64 ha. The area of the tankbed itself is about 28 ha. The tank is mainly fed by runoff-water from the catchment, which is 1583 ha.,and by streams from the hilllocks[2]. The way the catchment area is cultivated and conserved determines the amount of siltation of the tank and the flow pattern of the runoff-water (see Appendix erosion). Because of increasing siltation during the last 25 years, the storage-

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[1] The number of tanks in Kolar district is 2745, which is 12% of the total number in Karnataka, in Tumkur district there are 1511 tanks(7%)(Rama Prasad,1983, p.).

[2] A study done by the Department of Public Works, 1978 shows that 18.9 Mm[3] of water flows into the tank from which 18.0 Mm^3 comes from the catchmentarea and only 0.9 Mm[3] comes as surpluswater from 2 above tanks in the watershed. The estimated supply which can be taken up by the tank is 16.3 Mm^3, so about 0.3 Mm^3 will be surplus water which together with tal-endwater from the commandarea flows to next tank.

capacity of the tank has decreased to more than 50%[3]. At the same time there is a change of runoff characteristics from the catchment: less water infiltrates at those places where rain falls and it runs immediately to the tank. Hence the tank fills up in a shorter time with risk of overflow, even before the growing season has started. Farmers of Gatlagollahalli have raised the wasteweir to avoid overflow. The Public Works Department did not take any initiatives to bundraising. Raising the wasteweir proved to be very dangerous, which was proven by the fact that in august of 1987 there was a breach in the bund after the tank had filled up within two days of rains.

Increase of waterdemand

Allthough the water availability has decreased due to siltation and shortage of rainfall, the water demand in the command area has increased as the command area itself augmented. From the early seventies onwards more and more farmers started to irrigate their fields by lenghtening and tapping the main canals. In this way, in 1987 80 ha. in stead of 64 ha. had to be irrigated from the tank. Those extra 16 ha. were never sanctioned. With the remaining water it is still possible to irrigate the entire commandarea during monsoon, but it has its consequences on the choice of crops which can be grown (8.3.3).

Underexploitation of Springcanals in Gatlagollahalli

A fertile track in the taluk to which Gatlagollahalli belongs, is irrigated from springs or 'talaparidges'. These springs are dug up in various places such as alluvial terraces, riverbeds and in or behind tankbunds of some tanks. Such springcanals, as we will call them from now on, can also be found in the Gatlagollahalli tank. As they even do not dry up in summer, they are still the main source of irrigation in summer when the rest of the tank falls dry. There are two spring canals in the tank, having canals which lead to the main outlets in the tankbund.(see fig. 5.1). Every day people have to deepen those springcanals to keep up with the falling groundwater tabel. This groundwater tabel fluctuates between the seasons.

Even if there is no water in the tank during the dry season farmers still are able to grow some crops in the commandarea using water from those springcanals. Out of 80 farmers who take water from the left maincanal, 60 farmers are able to get water from the springcanals. Out of 80 farmers who are connected to the right maincanal, only 12-16 farmers actually take water from the right springcanal. As only these farmers are deepening the springcanal, only for them there will be sufficient water. This means a severe underexploitation of the available water which can be taken from the springcanals when every farmers helps to deepen. Underexploitation more over will stress drought problems.

According to the farmers there is one physical reason for this underexploitation of springwater. Severe erosion problems in the catchment siltated the stream, river, which ends at the foreshore of the tank. As this river is close to the right springcanal, farmers say that the siltation problem of this right springcanal is worse than at the left

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[3] In 1978 accumulated silt in the tank was about 5.5 m.

springcanal. During the seventies the Public Works Department initiated the construction of a stone-made bund near the spring, but it was washed away after the first storm. The farmers themselves never again tried to construct such a bund. Compared to the left canal, however, the wateravailabilty of the right canal may be better as deepening of the left springcanal is limited due to a rocky sub-surface.

Tanksiltation in Kanithalli

The tank from Kanithalli is only used by this village. It has a catchment of 518 ha. The watersupply of the tank depends on a great extend on the way in which water from other connected tanks is used, as much of this water is surplus-water[4]. Due to severe erosion the tank and the drainage-system siltated. The average depth of the tank has declined from 3 to 1.5 m. At the spillway the silt reaches the crest. Due to lack of maintenance also the two main outlets in the tankbund got siltated. Some farmers estimate the actual siltationrate at 0.2 m. per year. Consequently the storage capacity of the tank declined and less water is available for irrigation. Neglect of soilworks in the drylands caused even more unpredicted runoff than in Gatlagollahalli. No measurements to increase the storage capacity , such as desiltation or bundraising are undertaken. Hence sever underexploitation of surfacewater takes place in Kanithalli. Water which could be used to overcome droughtproblems which threaten large groups of Kanithalli's inhabitants.

No use of the commandarea

Hardly any water is taken from the tank due its siltation. However, in case that whenever the main outlets are properly maintained it is still possible to irrigate some crops in the commandarea. Also great parts of the maincanals are badly maintained and consequently collapsed. Formely, one of the two maincanals, the right one, split up into two branches or sub-canals. Due to severe waterlogging and siltation of canals one of the branches went out of use. This waterlogging is due to insufficient soilmanagement under the tankbund and neglect of draining facilities. Some farmers who still try to get some water from the tank made a new branch to avoid waterlogging parts under the bund. Lack of management and conservation measures made the commandarea barren and deserted. Farmers are forced to look for alternative watersources.

8.2.3 Overexploitation of groundwater

A solution to rainfall shortages and underexploitation of surfacewater may be found in groundwater exploitation.Farmers are not depending on rains anymore, but on available groundwater sources. However the potential of groundwater is not unlimmited. In Tumkur and Kolar district the contribution of groundwater to total irrigation is increasing. Recent studies on groundwater exploitation are not available, but using census from the seventies already indicate some future developments. In 1956

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[4] A PWD-study from 1939(!) shows that the tank is fed with 6.4 Mm^3 of water from the catchment and with 10.2 Mm^3 of water from four other tanks. In 1939 the estimated supply which could be taken up by the tank was 15 Mm^3 of water.

17.5% of irrigated lands of Karnataka were fed by wells. In 1972 it already was 31.8% (Irrigation wells, 1975).
The groundwater body is re-chargable mainly through percolation of rainwater and seepage from surfacewater bodies and irrigated land[5]. The average annual watertabel fluctuation between the seasons is estimated at 3.5 m. in Kanithalli and 2.6 m. in Gatlagollahalli. We found even fluctuations up to 10 m.
The groundwater discharge takes mainly place by drawing water from wells for irrigation purposes and domestic use and to a little extent through lateral flow contributing the base flow streams.
Already in the seventies overexploitation of groundwater took place in both Kolar and Tumkur districts, due to increase in the total number of wells and the extraction capacity caused by increasing power of engines.

Fig 8.6 The degree of overexploitation of groundwater in Kolar and Tumkur in 1974.

	annual recharge (MM^3)	annual discharge (MM^3)	ratio x 100%
Kolar	252.23	440.70	175%
Tumkur	828.42	300.91	106%

Source: report on census of Irrigation wells Karnataka, part I and part II, Government of Karnataka, bureau of Economics and Statistics, 1975.

8.2.4 Decrease of waterstorage in the drylands

Besides the cultivation of wetlands which are irrigated by tank or wells, many farmers also depend on dryland agriculture. These crops fully depend on local preciptation and on the possibilities to conserve water in the rooting zone of these crops in the drylands. In the Annex `Erosion' more information is given on the main soil characteristics of the Alfisols or 'red soils' which are found in Gatlagollahalli (red-loamy) and Kanithalli(laterite-gravelly). The water availability in these soils is least predictable. Rainstorms with intensities of exceeding infiltrability cause the building up of free water on the top of the soil surface. A

[5] It is estimated that taking rocktype, structure, wheathering, soiltype, rainfall, evapotranspiration a.o. in to consideration, only 5% of the rainfall would percolate and augment the groundwaterbody annually. In addition about 15% of irrigation application would also seep underground and benefit in recharching the groundwater (R. Shantharaju, J.H. Gurarajanna, 1976).

great amount of water will runoff to the tank and is lost to benefit dryland farming[6].

To guarantee sufficient water availability in the drylands specific soilmanagement measures are needed. The storage capacity of the rooting zone declines due to erosion of the topsoil and due to neglect of water-conservation measures. Light erosion in Gatlagollahalli and severe erosion in Kanithalli decreased the rooting zone. Consequently less water is stored in the profile. In Kanithalli hardly any soil conservation measures are undertaken, consequently most water will be lost for the dryland farmers.

[6] The infiltrability of red soils can be low and frequently below rainfall intensities because of slacking of the surface. Moisture retention capacity is frequently low (75-125 mm/m profile), which may cause a problem when the spells between storms are too long.

8.3 THE IMPACT OF DROUGHT ON NATURAL RESOURCE EXPLOITATION

8.3.1 Introduction

Drought has its impact on the way in which the local natural resources are exploited. As soon as the present basic needs statisfaction can not be fullfilled, villagers are forced to look for alternative techniques of land- and water management .
In the case of water scarcity two main alternatives are found:
1) In stead of tankwater exploitation, farmers try to exploit groundwater and riverwater (see 8.3.2 and 8.3.3).
2) Farmers change their cropping pattern (see 8.3.4 and 8.3.5).
Consequently there will be a change in crop production, the diversity of the species and the regulation of the biomassflow within the total landusesystem. Farmers try to apply the still available water in such a way that crop production is guaranteed and yield risks are reduced. But the value which is set upon the exploitation of wetlands, gardenlands and drylands changes. In Kanithalli, more than in Gatlagollahalli, re-organisation of waterexploitation, capital investment, labour supply and other inputs leads to deterioration of dryland conservation (see 8.3.6).

8.3.2 Groundwaterexploitation in Gatlagollahalli

In 8.2.2 it was concluded that due to a lack of tankwater and an increase of commandarea, ,the total water availabily per farmer declined. More and more farmers exchange the communal use of tankwater as the main source of irrigation to individual drawing of groundwater and riverwater, whereby tankwater will only be used as an additional source. Further development of groundwater exploitation may lead to greater overexploitation (see 8.1.2). Sustainable groundwater exploitation in Gatlagollahalli is studied through present and future water availability.

Development of well-irrigation

Fig. 8.7 shows the present number of irrigation wells in Gatlagollahalli.
Fig. 8.8 shows the number of wells in 1959-60.

fig 8.7 Irrigation wells in the drylands and the wetlands of Gatlahalli, Gatlagollahalli and Baraka, 1986-87.

Means	Gatlahalli	Gatlagollahalli	Baraka	TOTAL
Lift manual	6	12	15	33
IP	6	5	10	21
diesel	4	3	8	15
total	16	20	33	69

Source: records Village Accountant, Bukkapatna

Fig. 8.8 Irrigation wells and open pits in the drylands and wetlands of Gatlahalli, Gatlagollahalli and Baraka, 1959-60.

	Gatlahalli	Gatlagollahalli	Baraka	TOTAL
dryland wells	5	1	21[1]	27
open dry-land pits	-	2	1	3
wetland wells	3	4	2	9
open pits in wetlands	1	7	2	10
Total	9	14	26	49

Source: Department of Landrecords, Madhugiri.

When we compare both tabels, we see that the total number of wells has increased from 49 to 69. Out of these new wells, 11 were constructed only the last seven years. There has also been a considerable change in the means of drawing water from the wells. Most wells in 1960 were lined or unlined wells from which water was lifted manually. At some occassions water was lifted by bullocks, or kapile[2]. No well was electrified. Beside these wells there were also 13 open pits[3], mostly in the gardens of the commandarea.

In 1987 out of 69 wells, 21 were lifted by IPS and 15 by dieselpumps, both having a much higher discharge than the traditional manual wells[4]. There are still 33 of those manual wells, but only one open pit and one kapile are left.

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[1] The great number of wells in the drylands of Baraka may be distorted as all these wells are found near the tail-end of the commandarea. At those parts wells form the main irrigation source. At present those parts are counted within the official commandarea, in 1960 they were not. In those days some farmers from Baraka organised themselves in a so called 'Surfacewater Committee', but this does not excist anymore. The committeetook care that the surpluswater from the commandarea was equally devided among the tail-enders so that the water was not lost.

[2] A bucket is lifted by a pair of bullocks moving up and down a steep ramp, pulling the buckets by means of a rope passing over an elevated pulley. The leather bucket is stitched on a hose. As soon as the hose and the buckets are filled up, they are pulled up by the ropes and emptied in a fieldchannel.

[3] An open pit is a shallow, wide dug out pit from which water is drawn manually by buckets. The pit is also used as a drinkingplace for grazing of draftanimals.

[4] dischargecapacity of 2 m./day were found.

Increasing groundwater exploitation in the commandarea

Increasing attention for well irrigation may severe the underexploitation of tankwater and even lead to overexploitation of groundwater sources. The changes of discharge and recharge of water from the wells at different parts of the commandarea, the deepening of wells and the effects of waterlifting on the recharge of other wells are used as an indication of (future) groundwater shortages. In Gatlagollahalli the use of wellwater still depends on the access to tankwater.

TAIL-END

Fig 8.7 shows that most wells are in Baraka, where the accountability of getting water from the tank is lowest. At times of waterscarcity most tail-enders use wells as a main source of irrigationwater. The wells are scattered all over the tail-end part, even at higher places. Compared to top-end and middle part of the commandarea the number and the sizes of wells at tail-end is much higher. They reach depths upto 15 meter with a diameter of 7 meter. Many times they are even supplemented with a borewell upto 20 meter. The recharge per well decreased from 2 meter per day before 1983 to 0.5 meter per day in 1987. Although the increase of wells is considerable, the wells are still not effecting each other. An exception must be made for gardens with more than one well within 50-100 meter from each other; discharge from one well causes decline of watertabel in other wells.

TOP-END

At top-end there are only a few wells as there is sufficient access to tankwater just under the tankbund. The groundwater level is relatively high due to waterstorage of the tank. There are also some wells near the lowest parts in the commandarea, along the river and the drains. In contrast to the tail-enders, top-end farmers use wellwater only as an additional source to tankwater, e.g. between two different irrigation gifts from the tank or in order to give more water to highly waterconsuming gardens. Seepage from the tank favours well recharge. Close under the tankbund rice and fingermillet receive additional irrigation from unlined shallow wells, with an average depth of 3.5 meter an a diameter of 3 meter. In times of tankwaterscarcity wells are mainly used to maintain the gardens. These gardenwells reach depths of 7 meter and are all electrified. Allthough the wateravailability from the wells declined to 1.5 meter per day in summer, it was not necessary to deepen them recently.

MIDDLE-PART

Also in the middle of the commandarea most wells are only found near the river or drains as reaching the groundwater will be easiest at those places. During the tankirrigation season, those wells along the river always have sufficient water. Even in summer season some wells have a recharge of 2.5 meter per day. From 1983 onwards, the wells near the drains at higher places of the commandarea are suffering from watershortages. Despite deepening from 6 to 7.5 meter the recharge declined to 0.5 meter per day. Two farmers tried to construct a borewell, but failed due to the rocky sub-surface.

Still sustainable groundwater exploitation

Some concluding remarks from this paragraph can be made. The water availability from tank- and springcanals decreased. Still farmers try to benifit as much as possible from tankwater, but underuse springcanalwater. Waterscarcity more and more stresses the exploitation of groundwater. Although there are some problems at tail-end and the overall water availability per well decreases, exploitation of groundwater in Gatlagollahalli did not go beyond the limits of groundwater potential. Wells are only used in addition to tankwater and they can only be found at hydrological viable places. Wells hardly dry up, but deepening is becoming necessary. Further development of wellirrigation will certainly lead to overexploitation of groundwater.

8.3.3 Groundwaterexploitation in Kanithalli

Severe underexploitation of still available surfacewater sources stresses the importance of groundwater exploitation. This is thought to be an important and economically viable alternative to tankwater. Unfortunately the groundwater sources have their limits, as is evident in Kanithalli

To a greater extent than in Gatlagollahalli, the development of well-irrigation has influenced the way the commandarea, the gardenlands and the drylands are conserved. Development of wellirrigation in the commandarea is impossible as the soil characteristics limit further deepening. New wells were mainly constructed in the lowest parts close to the commandarea. These well-irrigated lands are called gardens as originally also vegetables where grown besides mulberry and fingermillet. From the late sixties onwards the importance of communal tankirrigation shifts to individual groundwater use. We studied the development of wellirrigation plotwise[5].
Figure 8.9 shows the development in Kanithalli.

Figure 8.9. The development of wellirrigation in Kanithalli

	65-66	75-76	85-86
number of fields irrigated	30	50	56
total area irrigated(ha.)	27 ha.	65 ha.	101 ha.

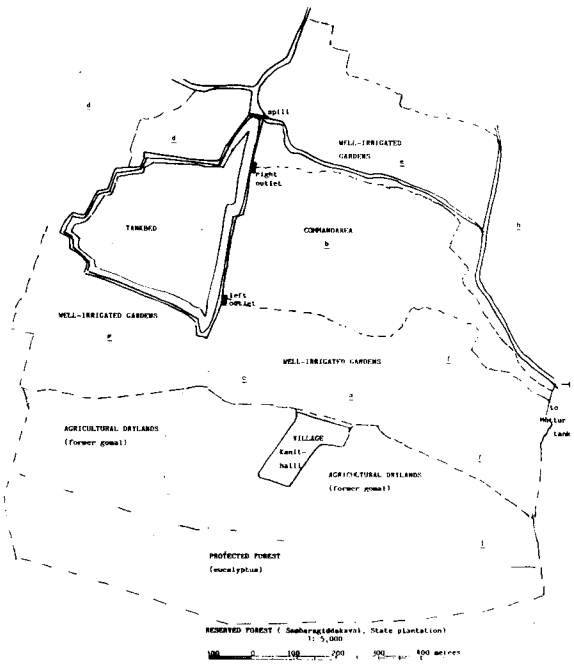
Source: Records Village Accountant

Within the period 1965-76 the number of plots which were irrigated by wells almost doubled and so did the total acreage under wellirrigation. In the period 1975-86 the number of plots under wellirrigation only slightly increased, but the total acreage under wells increased moreover. This can be explained by the fact that in 1975 already on all plots

[5] Surveynumberwise information on croppingpattern and irrigationsource was collected from the Village Accountant.

(where wellirrigation is possible) one or more wells could be found. However at that time only a small part of each plot was irrigated by wells. Water from wells was used to irrigate some vegetables or it was only used in addition to rainfall- and tankwater. In 1985, however, most plots where totally well-irrigated which explains the increase in total acreage irrigated. Further intensification is only possible by increasing the number of wells per plot or by deepening each well in order to guarantee sufficient recharge.
With the help of fig. 8.10 the development per landusetype can be discussed.

Fig. 8.10 The development of wellirrigation in the different landusetypes of Kanithalli.



Source: fieldsurvey W. Kloezen, Kanithalli 1987

Source: fieldsurvey W. Kloezen, Kanithalli 1987

a) The area between the village and the commandarea used to be the traditional garden area. It was close to the village which facilitated the guarding of the expensive vegetables. From the sixties onwards there is not much change in the number of plots irrigated. But the number of wells increased to 11. In 1987 there was also a borewell with 10 outlets.
b) The number of wells in the commandarea is still six and further developement is impossible.
c) In 1965 only two plots in this area were irrigated. In 1975 there were wells on most plots. In 1987 9 wells had to irrigate almost the entire area.
f) In 1965 there were already some wells at tail-end of the commandarea in order to addition to the tankwater supply. In 1975 wells totally had taken over tankwaterirrigation in the lower parts. In 1987 34

wells are scattered all over this area even at the higher places. In most plots more than one well was constructed, all effecting each others recharge.

d-e-g) Originally in these areas, on the higher grounds far from the village, only dryland crops were grown. In 1965 there was no well in these areas, even in 1975 area e was still dryland. In 1986 more than 50% of all plots in d and e and all plots in g are well irrigated. Totally we counted 42 wells in these areas only.

h) Allthough these fields at the very tail-end do not belong to Kanithali we surveyd the area and counted 20 wells, which are all constructed the last ten years.

i) Area i is totally dryland area with agricultural fields and forest. These are the higher parts of the catchment area and are considered to be for wellirrigation as the water tabel is too much below the surface. But even there we found an increase of wells from the early eighties onwards. Too reach groundwater some farmers tried to use borewells, but they failed.

Drying up of wells

There are hardly any possibilities left to put more land under well-irrigation. The history of Kanithalli also learns that the recharge per well is limited: wells dry up and further deepening is only done by those farmers who are able to invest money. The last alternative to try is the exploitation of groundwater through borewells, but even those borewells can not give sufficient water to fullfill the water requirements of the gardens. The depth from the open wells increased from 4-12 meter in the sixties to even 30 meters in 1987. Already in the seventies farmers had to leave well-irrigation as they could not afford further deepening[6]. In the early seventies all wells had sufficient daily recharge, over 3 m. per day. In 1987 recharge decreased to only 0.5 m. per day in the summer.

The loss of tankwater exploitation accelerated the unsustainable exploitation of groundwater in Kanithalli. Increase in number of wells and further deepening is impossible, many wells dried up and the landscape around Kanithalli is changing into a 'moonlandscape,' accentuated by the many heeps of sand which remain after a new well have been dug. Unfortunately the way back to sustainable exploitation of both surfacewater and groundwater is very difficult. The farmers try to look for alternative water sources, but groundwater exploitation by borewells seems to be the only possibility left. But also this form of exploitation is limited; some farmers who tried borewells already gave up as also these bores supply little or no water.

8.3.4 Drought and wetlandcultivation in Gatlagollahalli

Commandarea. Generally there are two growing seasons. During the early monsoon fingermillet is grow. Even at the end of the monsoon and at the beginning of the dry season rice is grown by means of tankwater. Well-irrigation extend the growingseason and it eliminates dryspells during

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[6] During our fieldsurvey we found the following well depths:area a:18-23 m.; b:dried up; c:26-28 m.; d and e:15-30 m. f:23-30 m.; i:34 m. plus borewell. Borewells in i should go uptill 250 m. to give enough water. All borewells uptil 90 m failed.

the rainy season. In chapter 5 we described the cropping pattern of Gatlagollahalli. To understand the watermanagement within the commandarea some more remarks are given. It is interesting how the cultivation of Pongamia trees which grow along the rice fields determine the cultivation of rice. The leaves manure the soil and the twigs are plowed under the soil in ordrer vto promote the internal drainage of the soil.

Gardens: The commandarea accomodates five plots which are considered as gardens; they have perennial and annual crops which need year round irrigation . The gardens are irrigated by tanks, supplemented by wells.

Tank- and riverbed: On the tankbund cultivation is prohibited as the roots may penetrate the bund and cause leakages. The river meanders through the lower part of the commandarea. In the summer most parts of the riverbed remain dry. There is only some water in small parts of the riverbed where farmers draw water for irrigation purposes by means of pits (see 8.4.4).

Changes in cropping-pattern

Yields: It is said that before 1967 even three crops could be taken from the wetlands within one year. If there is sufficient water available there will be a preference for rice-cultivation. Due to drought the number of cropyields declined from 3 to 1 per year. In 1987 only one crop, fingermillet, could be grown. Farmers wait as long as possible to start with their rice-nurseries. In case of late onset of rains, they decide to leave the rice and start fingermillet cultivation. Some farmers prefer jowar or groundnut. Groundnut, traditionally a drylandcrop, is mainly grown at tail-end. Fig. 8.11 shows the change in number of cropyields per year.

Fig. 8.11 Average number of yields per year in the commandarea of Gatlagollahalli.

period	number of yields per year
before 1967	3
1967-68	2
1968-77	1
1977-78	2
1978-87	1

Source: fieldsurvey, July 1987

Garden maintenance: According to the villagemaps of 1968 there were 15 gardens in the commandarea. Before 1968 there seemed to be even 25 of them (personal inquiry). At present there are only 5 gardens left. Hence also the diversity of crops, the quality and quantity of crops declined. Traditionally all gardens were mixed-and intercropped, however due to less wateravailability farmers decide to quit some species. 25 years ago sugarcane, a crop which needs year round irrigation, was grown by at least 50% of the farmers.At present the crop totally vanished. More and more the cultivation of vegetables, mixed with arecanut and coconut is

replaced by the cultivation of fingermillet, groundnut and jowar.The availability of groundwater and springwater enable some farmers to maintain their gardens. Often only some coconut trees remain at the fieldbunds, all other trees dried up.

The interest in garden maintenace is very high. During dry season all available water will be given to the gardens. Consequently all other plots are left fallow. Also whenever waterscarcity occurs during the growingseason of rice or fingermillet first the water is given to the gardens. Consequently the area under rice declined or disappeared and is replaced by fingermillet or groundnut. As said, gardens need year-round irrigation. Some farmers are not able to fulfil the crop water-requirements of those gardens and decide to replace the trees and vegetables by less waterconsuming mulberry. Even some rice cultivation is replaced by mulberry.

Drought causes yield-risks and effects the quality of the gardens. Normally the gardens are irrigated once in 10 days, but due to drought irrigation is possible only once in 15 days. Consequently the arecanut yield declined with 35% and the coconut yield declined from an average of 50 fruits per tree to 50 coconuts per tree.

8.3.5 Drought and wetlandcultivation in Kanithalli

Traditionally, the agricultural system of Kanithalli used to be more or less the same as in Gatlagollahalli (5.4). At present little can be found of this landusesystem. Decrease of rainfall and underexploitation of tankwater have led to groundwater exploitation in order to irrigate the gardens (8.3.3). Consequently also the croppingpattern and hence the nutrient in- and output changed. Emphasize on new cashcrops caused futher exploitation of alternative watersources. To understand the relation between water availability and cropping pattern, attention is given to the change of cropping pattern in Kanithalli.

Commandarea: Some older farmers recall that there used to be at least 5 gardens in the commandarea. At present only 5 dried up coconuttrees remind us of those disappeared gardens. Fig 8.12 shows that cereals form the most important crops in the commandarea. At first paddy replaced fingermillet cultivation, but due to decreasing tankwater farmers again fall back to fingermillet. In 1985 about 62% of the commandarea was under fingermillet and 30% remained fallow. Most striking is the introduction of eucalyptus in the commandarea, which moreover shows the loss of interest in staplefood production by some farmers. The available tankwater which is left is used to grow these trees which need little attention but supply high cash.

Fig. 8.12 Development of cropping pattern in the commandarea of Kanithalli (1965-87) (%)

	65-66	75-76	86-87
fingermillet	14	10	62
paddy	67	75	-
fallow	17	13	29
eucalyptus	-	-	4
Jowar HYV	-	-	5
other	2	2	-

Source: W. Kloezen, from records Village Accountant Kanithalli

Gardens: Fig. 8.10 shows that in Kanithalli the gardens are found everywhere except in the commandarea. Traditional well-irrigated crops were mulberry, fingermillet and vegetables. Fig 8.13 shows that the increasing possibilities to wellirrigation replaced vegetables like garlic, onions, patatoo, but also banana and maiz in favour of cashcrops like sericulture and cashcrop.

Fig. 8.13 Development of croppingpattern in the well-irrigated gardens of Kanithall (1965-87) (%).

	65-66	75-76	86-87
grapes	5	7	39
mulberry	2	35	39
fingermillet	23	7	20
maiz	2	20	-
groundnut	6	2	-
sugarcane	4	2	-
jowar HYV	-	7	2
vegetables	22	5	-
fallow	6	7	-
paddy	-	8	-

Source: W. Kloezen, from records Village Accountant

Tankbed, river and bunds: Lack of maintenance of tankbed and riverbanks frustrated traditional cultivation in the tankbed, fishery and pongamia and bamboo-cultivation. Only at the tankbund pongamia is found, due to the fact that the waterman, who is responsible for cutting these trees to prevent bundbreaches, neglects his duties (see 8.5.1).

Kanithalli vs. Gatlagollahalli: less diversity, less quality

We argue that the development of wellirrigation diversifies the croppingpattern when compared with the cropping pattern under tankirrigation as is stated by N.D. Kamble (N.D. Kamble and Abdul Aziz, in M.V. Nadkarni ed., 1979: part 4, p. 17-19). Due to neglect of commandarea irrigation, many crops vanished, as all traditional gardens disappeared. As long as the available ground-watersources are not depleted, well irrigation may

reduce individual yieldrisks, but it still needs a private investment which is only economically viable in case of cashcrop cultivation. In Kanithalli this led to monocultivation. Toget
her with the trees, vegetables and traditional cereals also those management techniques disappeared which guaranteed sustainable conservation of most landusetypes and natural resources. In Gatlagollahalli the wetlands, including the gardens, still form only one component in the total biomassflow between the landusetypes (see fig, 7.34). With the further development of wellirrigation and wellfed cashcrops more and more nutrients like green manure, silt and cowdung accumulate in the gardens. In Kanithalli most natural resources are depleted in favour of gardencultivation. The commandarea as well as the drylands are barren. Even red soils from the reserved eucalyptus forest is illegally transported to the grapegardens. As soon as also groundwater as lender of last resource (which in this case is groundwater) is depleted, hardly any agricultutral resource base is left.

Now we have some insight in the relation between drought or decrease of available watersources and the change of croppingpattern and wetlandconservation. To understand this relation also more insight is required in the social and economical changes of the village and the role of policymaking on development of wellirrigation and the introduction of gardencrops (see 8.4 and 8.6).

8.3.6 The impact of drought on drylandcultivation

Gatlagollahalli

Rainfed farming completely depends on local rainfall and the possibilities to store water in the profile. This is defined by access and control over water-and soilconservation measurements. When both these components are liable to diminution crop production decreases and drylands will degrate. In Gatlagollahalli the total acreage of dryland cultivation increased due to the granting of gomal to individual farmers. Because of the great importance which the farmers of Gatlagollahalli still give to fingermillet, mixture crops and groundnuts, these lands are conserved as much as possible. Hardly any field will be kept fallow for years. Fingermillet is also grown as it is drought resistant. Mixture crops spread risks which are due to uncertainty of rainfall. However, due to increasing uncertainty over water availability we noticed some changes in the attention given to dryland cultivation.

If farmers own both wetlands and drylands, the interest in wetland investment is prefered above dryland investment. Allthough the wateravailabilty in the wetlands also declined, the security of access to water is still higher in those wetlands which compared to the drylands. Diggingof wells in the drylands is hardly possible because of rockformations. Consequently in times of waterscarcity welldigging is firstly done in the commandarea and the gardens. Also other inputs like labour, draft, silt and manure more and more are given to the wetlands, consequently less attention is given to soil- and waterconservation. As a result also the cropping pattern changes: farmers still keep some fingermillet, grow more groundnut - as it needs little manuring -, or they plant pongamia or tamarind trees. A greater part of the fields is kept fallow. Due to these factors the production of fingermillet by those farmers fell with 50-90% per farmer.

Some farmers only possess drylands. According to them the main problem of dryland cultivation is the loss of fertility and the uncontrolled runoff due to erosion and lack of levelling and bunding. According to them it is still possible to store profile water when enough attention is given to conservation. Of course they also admit the decreasing lack of rainfall, but the decline in groundnut,- mixture crops- and groundnut yields does not exceed 50% during the last few years. However less mixture crops are used as they are replaced by monocultures of HYV's, which are liable to waterstresses.

Catchment protection and wetland farming

Fortunately, in Gatlagollahalli farmers are still aware of the importance of dryland conservation for the lower parts of the watershed, i.e the wetlands. They admit that neglect of dryland conservation hazards the waterstorage capacity of the tank. To protect the wetlands, farmers try as much as possible to attune wetland farming to drylandfarming. This is possible as long as the introduction of groundwater exploitation does not effect farmers interest in dryland cultivation.

Kanithalli

The high emphasis given to groundwater exploitation not only effects the commandarea, but also influences the attention given to sustainable dryland cultivation. Individual farmers hardly invest in soil- and waterconservation measurements to protect the soil from erosion and hence to guarantee sufficient profile storage. Fig. 8.14 shows the changes in croppingpattern from 1965 onwards. Compared to 1965 the percentage of fallow land decreased in 1975. Two reasons can be given:
1) after 1965 a considerable part of the barren gomal was granted to the Forest Department which started an eucalyptus plantation,
2) many agricultural dryland fields where converted into well-irrigated plots. Consequently, both the absolute area of fallow dryland and the percentage of fallow land decreased. We argue, however, that if these changes also decreases the quality of these and other natural resources, as, for example, the granted gomal now consists of degraded eucalyptus forests and the breakdown of garden cultivation moreover stresses the overexploitation of groundwater. The latter may explain the slight increase of fallow land in 1986: the wells dry up and the lands are reconverted into drylands. Another indicator of a decrease of sustainable management of resources is the shift to monocultures. Compared to 1965, in 1986 many crops disappeared and are replaced by fingermillet. Farmers declared that each year a great amount of the fingermillet yield is lost due to less water availablity. As a result the 70% of dryland under fingermillet will reap less grains as may be expected. There is a slight growth of farm forestry, but this will not contribute to dryland-conservation (see Annex Eucalyptus) and it depletes the groundwater table.

Fig 8.14 the development of croppingpattern in the drylands of Kanithalli (1965-87) (%).

	1965-66	1975-76	1986-87
fallow	43	13	19
fingermillet	36	59	70
eucaluptys (farmforestry)	-	3	7
dry mulberry	4	3	-
groundnut	-	1	-
honge	5	4	3
horsegram	10	5	1
dry paddy	1	4	-
maiz	-	7	-
others	1	1	-

Source: W. Kloezen, from the records of the Village Accountant.

8.4 THE SOCIAL DIMENSION OF DROUGHT IN GATLAGOLLAHALLI

8.4.1 The management of communal tankwater

Waterscarcity, whether from rainfall or the availability of tankwater forces farmers to look for alternative ways of managing their resources. In 9.3 we discussed that farmers find solutions in two different ways:
1) they look for other watersources, and
2) the application of tankwater changes: water is given to less waterconsuming crops or a specific crop receives less water.
Both ways will influence the social and economical position of individual farmers and landless labourers through a change of the accessability and distribution of the still available resources. In order to understand the changing social and economical position of villagers it is necessary to discuss how the distribution and maintenance of present and alternative resources are organised.

In Gatlagollahalli local tankirrigation has already been managed in the same way during some generations at least. The organisation of this irrigationscheme is a very complex one. In this communal irrigation scheme two organizational groups are highly integrated:
1) waterusers, those farmers who use tankwater to irrigate their fields. They all have specific rights and responsibilities with regard to tankwater management
2) waterauthority, those people regulate waterdistribution and system maintenance.
These groups are integrated because they are guided by the similar socio-cultural rules and because of the temporal circulations of farmers between both groups (after Coward, 1980:25-26). All the members of the water authority group in Gatlagollahalli are also farmers who use water from the tank. The formal members of the waterauthority are:
1) one neerghanti, the traditional waterman. He is a member of the Vokkaliga caste in Gatlahalli.
2) six canalleaders
3) beside these authoritymembers also an announcer and an ex-officio leader are appointed.
Hereafter it is made clear which functions they have in the conservation and management of tankwater.

Sustainable distribution of tankwater

In Gatlagollahalli tankwater is distributed in such a way that little water will be lost. The distribution of tankwater is traditionally based on the fact that every wetland farmer gets a quantity of tankwater which is proportional to landownership in the commandarea. By experience the canalleaders can tell the best moment to release water from the tank. Before this moment the canalleaders come together to assess the seasonal waterrequirements. Each farmer gets water on rotation. The quantity of water which comes into the fields is fixed as no adjustments at the main outlets in the tankbund can be made; the outlets give full supply or no supply at all.

If the farmers think that there is sufficient tankwater for a certain season or period, every farmer is allowed to take as much water as he needs. Consequently, as the water-requirements changes during the season,

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the time between two gifts also changes. At the beginning of the season the water-requirement is highest as much water is needed for preparation of the land, like fieldsoaking. Sometimes too much water is released from the tank, but the water will seep to the drains and the river. This surplus water is used at tail-end or it will flow to a tank further below.

When the canalleaders assess a scarcity of water during the growing season the total area that may be irrigated will be limited. Even the types of crops may be adjusted. ^During two occassions in the season this happens. Firstly when it appears that the onset of the monsoon is very late (see also 9.1.2), and secondly at the end of the growing season when there is a possibility of water shortage during the last growing-stage. Ofcourse in the latter case the area can not be fixed anymore, but every farmer gets less water. Some farmers decide to leave some of the crops, which will be used as fodder later on. The intervals between two watergifts and the watergift itself is fixed, no farmer is allowed to take more water than given by the waterman.

Before releasing the water from the tank it is also decided whether the application of water starts at tail-end or at top-end. Last five years it happened twice that land preperation started at tail-end[1]. The role of the neerghanti is restricted to the opening and closing of the main-outlets of the tankbund and fixing the time when an individual farmer may open his field-inlet. When a farmer takes too much water it is reported to the canalleaders, who may fine the farmer. Even if there is an abundance of water, farmers are not allowed to transfer their rights to water to other farmers or even to one of their own plots. Only when a plot suffers from severe waterlogging the neerghanti can decide to give water to another plot.

8.4.2. Waterscarcity and access to water

Drought or water scarcity lead to a changing social- and economic position of farmers as soon as the access to scarce resources is not equally devided. More and more farmers try to get access to alternative water-sources like groundwater. This leads to many conflicts among the beneficiaries of the tank as exploitation of tankwater is only possible as long as all farmers give full cooperation to communal irrigation activities. Hereafter we will elaborate how access to water is determined.

Three villagers make use of one tank: Gatlahalli, Gatlagollahalli and Baraka. The entire irrigation system is coterminous with the boundaries of these villagers, but the system is split up by the use of two main canals. The organisation around one canal runs independently from the other. Along each canal farmers of all three different villagers may use the water.

Right to tankwater is connected with right to land. As not every farmer possesses land in the commandarea, access to water is not equally distributed. People without land in the commandarea are also excluded from water from the springcanals. Hence, besides the size of land property

[1] There is no good reason given of the decision to start at tail-end.

also the place of land determines individual production. From fig. 8.15 can be concluded that irrespective of the categorie of landownership all farmers possess mainly drylands and only little wetlands or gardenlands.

Fig 8.15 The distribution of land among different categories of landownership in Gatlagollahalli, 1987

Category	average ha.	dryland %	wetland %	gardenland %
Landless	0.12[2]	100 %	0 %	0 %
Marginal	0.87	75 %	25 %	0 %
Small	1.65	83 %	17 %	0 %
Medium	3.40	77 %	23 %	0 %
Large	10.53	81 %	18 %	1 %

Source: fieldsurvey, 1987

The access to water is becoming more important when water scarcity increases. There is an indiscriminate distribution of wetlands and drylands in Gatlagollahalli, but also the place within the commandarea and the access to wells must be studied in order to understand to which extent farmers are vulnerable to drought. Fig. 8.16 shows the distribution of lands and wells among wetlandfarmers.

Most farmers of Gatlagollahalli have lands in the middle part of the commandarea as this is closest to the village. It is obvious that no large farmer has land at top-end, the most favourable part of the commandarea. 50% of the large farmers own wells, whereas only 14% of the marginal farmers have access to groundwater. Besides the water drawing capacity of each well also access to financial means, loans for further construction and deepening of wells or the acquisistion of electric pumpsets are factors which determine the quality and quantity of wetland production.

[2] Although these people are officialy considered as landless some do possess a little land, which they encroached, or in case that they own land with a legal tittle it is left fallow, and consequenly it is not recorded by the village accountant.

Fig. 8.16 The distribution of land and wells among the wetland farmers of Gatlagollahalli,1987

Category	Place	Tankfed	Tank and Well	Total
Marginal	topend	-	-	-
	middle	8	1	9
	tailend	5	1	6
	total			15
Small	topend	1	2	3
	middle	8	2	10
	tailend	-	-	-
	total			13
Medium[3]	topend	2	-	2
	middle	5	2	7
	tailend	6	1	6
	total			15
Large	topend	-	-	-
	middle	3	3	6
	tailend	2	2	4
	total			10

Source: Village Accountant Bukkapatna

Marginal farmers: 25% of the cultivation takes place in the wetlands. None of these farmers own recently constructed wells; it has been nine years ago that the latest well was constructed. Of course all farmers intend to deepen their wells or to construct new wells, however they all lack financial sources. Only some small loans from the PLD-bank were received (Rs. 5000-Rs.9000)[4]. As no farmer was able to repay in time, no one got subsidies from the bank. 50% of the farmers had to generate own financial sources by selling other means of production, like bullock-carts.

Small farmers: those farmers who only possess drylands could not find possibilities to construct wells in their fields. Also small farmers, like marginal farmers did not construct wells since 10 years. 50% of the existing wells are equiped with pumpsets. Sometimes there is a borewell within the open well. It needs Rs.10,000- Rs.20,000 for a bore.

Medium farmers: In contrast to marginal and small farmers, medium farmers much more find access to new wells, electric pumpsets and finances to deepen the wells. 33% of the wells are recently constructed. One farmer received the assistance of the villageleader to get a certificate from

[3] Two medium farmers have lands in the commandarea of the Bukkapatnatank. Three large farmers have lands in the commandarea of the Bukkapatnatank. The tail-end of this commandarea borders the tail-end of Gatlagollahalli.

[4] 1 dollar = Rs.13

received the assistance of the villageleader to get a certificate from the Department of Mines and Geology. This certificate is a pre-condition if one wishes to obtain a loan from the PLD-bank. Beside these loans all farmers assured to have sufficient own financial sources gained from agricultural production. The main limit to further well construction or deepening is not the lack of finances but the rocky sub-surface.

Large farmers: Large farmers already own more wells than other farmers, which reduces yield risks due to drought. As they have sufficient access to financial means, they are more interested in deepening existing wellsthan in the construction of new wells. According to some of these farmers, deepening still meets water-requirements.In stead of large investments in further exploitation of groundwater, the money is invested in houses or the cultivation of cashcrop production like sericulture. Money is easily obtained from own sources or from private lenders. The villageleader faciltate access to those private lenders.

Although many farmers have access to tankwater as they have lands in the commandarea, the access to groundwater is not equally devided. Especially marginal and small farmers will be confrontated with the impact of drought as they lack the possibilities to invest in alternative resource exploitation. Even if they own wells, they can not get the loans to deepen or construct wells. Large farmers still did not reach the limits of exploitation, hence drought has a different impact on their lives. These impacts manifest themselves through all kind of conflicts which are the result of increasing scarcity. We will discuss these conflicts in the next section.

8.4.3 Social conflicts around waterscarcity in Gatlagollahalli

Water scarcity increases social conflicts between different groups of agricultural producers, as there is a differentiated access to still available communal tankwater and alternative sources like groundwater, riverwater and wetlands in the ever increasing commandarea of Gatlagollahalli. Conflicts on the distribution of tankwater may arise at times of water scarcity as some farmers will try to take more water than allowed. At first the conflict will be solved between those parties involved, e.g. two neighbouring farmers. The canalleaders have the responsibility to judge the situation and to punish if necessary. Under severe circumstances the help of the villageleader, other influencial villagemembers or even a PWD-officer is applied for. Hence, anything is done to solve the conflicts within the village community. During our stay in Gatlagollahalli there was no governmental interference to solve the conflicts we recorded. As far as we noticed, no canalleaders used his power unfairly in solving a conflict between other farmers. We will describe some direct conflicts between (canal)leaders and farmers where those leaders used their social- and economical position to gain individual profits.

We divided the conflicts into three seperate groups of occurence, realising that these groups of conflicts all have their individual impact on the position of landless and farmers and that they are interrelated with each other. We distinguished:
A) Conflicts caused by the differentiated access to groundwaterexploitation.
B) Conflicts caused by the differentiated interests in maintenance of the communal tankirrigationsystem.

C) Conflicts caused by increasing illegal appropriation of communal land- and watersources.

8.4.4 Conflicts on groundwaterexploitation

We already saw that those farmers who own only drylands will invest more in these drylands, leading to better cropproduction and conservation, than those farmers who have drylands and wetlands. The latter group explained to be more interested in investments in groundwater exploitation. From the previous section it was concluded that only medium and large farmers are able to find suffficient financial sources to construct new wells, buy pumpsets or deepen their wells when necessary. For them the availability of groundwater sources more and more is regarded as the main source of irrigationwater as the water availability in the commandarea decreases which will further cause yield risks and degradation of their gardens. Whereas medium and large farmers try to avoid droughtproblems by changing from communal water exploitation (tank) to individual water exploitation (wells), marginal and small farmers are still dependent on access to tankwater and dryland farming.

Socio-economic evaluation of wetlandcultivation

Fig 8.17 A comparison of costs and benefits of irrigation tanks accruing to different participants.

Participants	Benefits	Costs	Comparison criteria
Farmer	Private net return at village prices Increase land-value Reduction in risk	Irrigation charge Obligations to contribute labor Uncertainty of water availability	Financial cost-benefit ratio
Project authority	Irrigation fees.Income from fish, brick making	Land acquisition Construction Maintenance Water fee collection	Financial cost-benefit ratio
Nation	Additional production at average prices	Opportunity cost of capital invested (Interest)	Economic internal rate of return
	Additional employment.Safety in food production.Increase groundwater Less soil erosion	Submerged land Higher watertable (increased salinity)	

Source: M. von Oppen and K.V. Subba Rao, 1987:15

The change from tank to wells has a major impact on the social- and economic position of the beneficiaries. Studies on the economic evaluation of tanks in semi-arid tropical India discuss benefits, costs and benefit-cost comparisons of tankirrigation. Fig 8.17 shows the costs and benefits of irrigation tanks accruing to different participants.

In this section we concentrate on farmers motivations to explain some of the changes from dryland to wetland cultivation. Some main conclusions are given here:

Landvalue: Benefits to wetland producers are calculated from private net returns at average prices. Some examples are given in fig. 8.18[5]. Important for our studies is the ratio of tank irrigated land value/rainfed land value, which shows the increase in landvalue. On the average, irrigated lands are valued to be 2.5 to 3.4 times more than dryland.

Fig 8.18 Farmers' benefits, costs and benefit-cost ratios at average prices for tanks in selected South Indian districts.

District	increase in landvalue (Rs./ha)			net benefit due to tank (Rs.)	cost of irr. fee (Rs/ha)	ratio
	Tank irr.	Rain fed	Ratio			
average tank in Medak (138 ha)	13544	4023	3.37	1171	35.6	32.0
average tank in Mabubnagar (94 ha.)	11134	4581	2.43	1201	33.1	36.3

Source: M. von Oppen and K.V. Subba Rao,1987:16

Yieldstability vs. Environmental stability

Tank- and wellirrigation generally reduce yieldrisks in comparison to rainfed cropping. Every season the irrigated area must be adjusted to the water availability from tank or well. Hence the advantage of yield stability is achieved at the disadvantage of area instability. However area instability, due to decreasing tankwater availability, can be compensated by increasing access to groundwater. This is highly preferred by those farmers who have land at tail-end, those who have gardens and those who started cashcrop production which need year-round irrigation. Hence for a specific small group yield stability and area stability are chieved by groundwater exploitation. However, both kinds of stability also bring disadvantages.

[5] This tabel can only be used as indication as the selected comandareas of this studie belong to the neighbouring State of Andrah Pradesh.

a) only a small group has access to groundwater. Those who are still depending on tankwater are not able to find possibilities to achieve these stabilities. Moreover, in this section we will see that stability-achievement through groundwater exploitation by large and medium farmers hazards tankwater exploitation of marginal and small farmers.
b) stability can only be achieved as long as groundwater sources are not limited. When sustainable groundwater exploitation shifts to overexploitation, both yield stability and area stability are jeopardized.
Taking both disadvantages into consideration it can be concluded that short term stability-achievement through groundwater exploitation by one group may destabilize the entire environment: commandarea and tankwater and groundwater resources.

Except advantages, wetlandfarming brings also some financial disadvantages there are also some financial disadvantages to individual farmers. In the case of tankirrigation, irrigation charges are collected. It is the duty of the Village Accountant to record whether a farmers grows a dryland- or wetlandcrop. The waterfees are taxes which farmers pay together with the landrevenues to the Revenue Department. We assume that the charges vary between Rs. 25-30/ha. per season. If, due to drought, a farmer is not able to grow crops for two successive years, he will be exempted from this obligation to pay tax. In the case of wellirrigation also charges have to be paid. But investing capital for the construction or deepening of wells is considered as the main cost.

Even though the farmer enjoys the benefit of reduced yieldrisks, he still faces uncertainty about the water availability of tank. The effect is probabaly a higher variability of paddy production than on rainfed production (ibed:20). This effect can only be reduced by further development of groundwater exploitation as long as over-exploitation does not occure. In Gatlagollahalli the drawing of groundwater is still below over-exploitation, hence in this case the variability of paddy production, gardens and cashcrop production is certainly reduced. However, only for the time being.

Groundwater exploitation and market-dependancy

The indigenous, communal irrigation organization in Gatlagollahalli is characterized by its capacity to mobilize communal labour for maintenance activities. Every member knows his responsabilities, realising the advantages which can be drawn from communal exploitation, e.g. certainty of access to water as the sustainable management of tankwater is regarded as a source of income for the total village. Eggink and Ubels (194:225) discuss the non-commodity character of indegenous, communal irrigation-schemes. In the case of Gatlagollahalli it is certainly true that water-distribution does not depend on cash economies as e.g. the leaders are paid in kind and do not receive any salary.
In spite of the existing communal irrigationsystem, more and more farmers get incorporated into the cash economy. Farmers get access to the modern means of groundwater exploitation. In section 8.6 [6] we concentrate on the

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[6] In this paper we will only concentrate on this system of market integration as it may be of specific use to understand the changes in management of natural resources. We will not elaborate the different issues of the commoditization process like the increase of labour through wages, the purchase of fertilizers and seeds.

role of government and other institutons like banks with regard to farmers' liability to marketintegration.

Above we stated that there is an increased interest in irrigated agriculture. This in contrast to drylandfarming. Two reasons were given: land value and yield stability. Both are economical features. But we need more factors to explain the change to wellirrigation and its impact on the environment. Eggink and Ubels (1984:226) discuss three factors which may determine farmers' liability to groundwater exploitation through markets:

a) peasant form of production
b) development and introduction of technologies
c) waterscarcity

These factors are briefly translated to resource-exploitation in Gatlagollahalli. In Gatlagollahalli the introduction of modern wellirrigation has increased the opportunity for medium and large farmers to extract more from their irrigated fields, however thereby leaving aside the potential crop production in the drylands (see 8.3.6). Landless labourers and other less favoured categories are obliged to stick to indigenous forms of production: subsistence production, mainly on dryland and tankirrigation, supplemented with manual wells. Appearantly the existing tankirrigation technologies can not guarantee sufficient water availability for everyone. As drought is still regarded as solely a physical problem (see 8.1.1), in stead of also a social and institutional one, solutions are sought in the introduction of new technologies to exploit natural resources (see 8.6.2). Also in Gatlagollahalli the actual drought problem is regarded as a depletion of the traditional water sources. This attitude makes indigenous tankirrigation powerless to gain solutions to drought and hence induces the installation of wells. However the change to wellirrigation can not fully be explained by the depletion of these traditonal watersources as these sources are not depleted at all. In 8.2.2 we saw that springcanal water in Gatlagollahalli is underexploitated in stead of depleted!

It is our opinion that the access to tankwater is moreover influenced by the changing social relations among the group of waterusers and the water authority.

Some conclusions on the social impact

- Only large and medium farmers benefit from the increase and development of wellirrigation, as it increases yield stability on the short run.
- Small and marginal farmers still depend on dryland farming and tank irrigation, supplemented with some wellirrigation. Communal tankirrigation however, can only benefit these farmers by the full cooperation of all farmers along the canals, including large and medium farmers. Whenever the latter withdraw from their duties as they are more interested in investments in wellirrigation, also for small and marginal farmers the accessability to tankwater decreases and effects their position. Without full cooperation tankwater is underexploitated, consequently large parts of the commandarea have to be kept dry and fallow.
- The uncertainty of water availability will decrease as long as there is no overexploitation of groundwater. In that case also the production of cashcrops and the maintenance of gardens is guaranteed. This will

mainly benefit the owners of gardens[7]. Both cashcrop production and garden maintenance is very labour consuming. This may guarantee sufficient work for landless labourers, and among them, women.

In 8.5.3 we will discuss into what extend the enormous development of sericulture in Kolar really favoured employment conditions and social position of landless and women in Kanithalli.

8.4.5 Conflicts on systemmaintenance, leading to underexploitation

In a communal productionsystem, like tank irrigated agriculture, the management of resources is totally linked with the cooperation of each farmer, irrespective of power and status. Activities where each farmer should know his responsibilities are the maintenance of the tankbed, bund and maincanals. Due to lack of cooperation the organisation of maintenance collapses. Consequently there is a different use of available water which leads to underexploitation. In Gatlagollahalli this can be seen in the case of exploitation of the right springcanal.

Maintenance activities

We will briefly describe the main activities on maintaining the tanksystem and the springcanals.

Canal cleaning:

At the beginning of the irrigation season, in June or July, just before the tank fills up, all farmers show their interest on irrigation by being present on the day of communal cleaning of the main canals. For each acre[8] the farmer possesses in the commandarea, he himself or a labourer has to come to do the work[9]. Defaulters are excluded for the entire irrigation season, except if they pay a Rs. 5 fine. The canalleaders are responsible for the success of the cleaning work and the mobilization of communal labour. Before starting the work all farmers are informed by the leaders through an announcer who goes to the houses of each wateruser. At 6.30 am. at the day of cleaning, the announcer beats the drum to collect the farmers. Only the maincanals are cleaned on this communal bases. Every sub-canal, or fieldcanal, is only cleaned by those farmers with adjoining lands.
There are only slight differences between the cleaning of the left- and

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[7] In Gatlagollahalli only large and medium farmers possess gardens. 12 families started sericulture, among them also small and medium farmers.

[8] 1 acre = 0.405 ha.

[9] Irrigationactivities such as waterdistribution and systemmaintenance are only undertaken by men. No women are involved.

the right canal[10]. At the end of the day the recordkeeper, who is one of the canalleaders, counts the absentees and informs the other leaders which farmer should be fined[11]. The neerghanti is informed not to give water if the farmer does not pay this fine.

Springcanal deepening:

To be guaranteed of sufficient watersupply from both springs during the dry season, the canals which are leading to the main-outlets should be deepened to keep up with the seasonal falling of the watertable. Each farmer who wants to make use of the springcanals has his responsibilities in the maintenance and deepening of the canals. In general we found that there is a rule that for each acre of commandarea one worker must be sent. However, dependent on the individual decisions of the canalleaders some adjustments can be made. The duration of deepening is adjusted every season[12].

Conservation and cultivation of the tankbed:

Besides the cleaning and deepening occasionally other communal activities of resource exploitation and conservation occure. When there is no water in the tank, pulses are grown in the lower parts of the tankbed. Hence, also during the dry season the tankbed is used in the best way. The tankbed is divided into three equal portions, marked by stones on the bund and in the tank. Each portions is communally cultivated by all households of one village. All households are involved, even those who are not using tankwater. Before sowing all villagers contribute money to cover expenses of buying seedlings and pesticides (Rs. 11 per household). After harvesting the pulses the households are paid in kind: in 1986 about 30 kg. of pulses per household. Sowing is done by women. Also one pair of bullocks and a plow must be supplied. Whenever a household is not able to send a pair of bullocks, only half of the share is given. From each village one of the leaders keeps the accounts.

Small bund repairs are done by the farmers themselves. In the case of bundraising or bundbreaches the PWD's assistance is applied for. Culti-

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[10] Leftcanal: about 78 farmers make use of 33 ha. of commandarea along the left maincanal. The total canal is divided into 78 portions from top-end upto tail-end. A farmer with adjoining lands to portion no. 1 has to cooperate with the cleaning of this portion only. A farmer at tail-end has to assist untill the entire left maincanal has been cleaned as 'his' water flows through the enire canal. Rightcanal: about 80 farmers make use of 32 ha. The total lenght of the right maincanal is divided into three portions. All farmers who have land in one of these portions have work together untill the entire portion has been cleaned.

[11] The collected fines are used for small repairs and for the yearly pujas which are held at the first day of water realising from the tank. Another puja is held when monsoon holds of. All castmembers perform puja in the tankbed to ask for rain.

[12] from the recordbook of the left springcanal we found that in the months of May and June(dryseason and empty tank) of the years 1980-86 50-60% of the total labour input occured. Of course it depends on the actual water availability whether deepening is necessary or not. We estimate, again from the record book, that each season every beneficiary of the springcanal has to attend five times for deepening.

vation on the tankbund is prohibited as the roots destroy the bund. Each farmer takes as much silt from the tank as needed. As the quality of the silt decreases due to erosion, less farmers are interested to transport silt to the drylands. Every five year the siltation along the springcanals is communally removed as it makes the canals deeper and deeper, which makes maintaining even more difficult .

Underexploitation of the right springcanal

In general it is assumed that during monsoon the maintenance of the total irrigationsystem causes no problems. Now we will concentrate on the problematic organisation of waterexploitation of the right springcanal.During dry season,only 12 to 16 out of 80 farmers along the right canal want to make use of water from the right springcanal during dry season. As only a small number of farmers are actually deepening those springcanals little water can be takan from it. As a result there is a severe under-exploitation of water, which strenghtens the drought problems for those who do not benefit. When we asked the farmers we got different explanations for this phenomenon. A physical reason, siltation of the springcanal, is already described in 8.2.2. Hereafter we elaborate on the social causes.

A marginal farmer at tail-end declared that even in the early seventies sufficient water could be taken from the right springcanal. Later on most farmers lost their interest in maintenance activities. The farmers give *several reasons:*

- The opportunity to work as a labourer outside agriculture becomes more important. Possibilities are a.o.:
  * slabstone making
  * fuelwood collection from the Siddlaghatta forest for marke ting (see 7.4)
  * contractwork, like digging of new wells

  Some farmers from Gatlagollahalli also found work as a teacher. Especially marginal and small farmers look for these opportunities as they declare that these alternatives are less labour intensive compared to the severe job of deepening. Hence, also during the dry season, when cultivation of your own plots under drought circumstances is very risky, a daily income is guaranteed. Compared to the leftcanal the number of marginal and small farmers along the right canal is high[13].
- An increasing number of medium and large farmers concentrate on wellirrigation and garden maintenance, rather than on communal activities like canal deepening. They withdraw, and as a result the deepening is done by a smaller group, mainly marginal and small farmers. The latter is still dependent on springwater as they hardly have access to groundwater. This unfavourable group complains about the unloyal attitude of the medium and large farmers.

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[13] The middle and tail-en part of the rightcanal is not fed with springcanalwater. These parts are used by farmers from Gatlagollahalli. The percentage of marginal and small farmers from Gatlagollahalli is 54%. The top-end part of the right canal and most of the leftcanal is fed with springwater. These parts are used by farmers of Baraka and Gatlahalli. 26% of Baraka and 33% of Gatlahalli are marginal and small farmers.

- Also the lack of reliability and responsibility of the (canal)leaders is regarded as one of the main causes to underexploitation of springwater.

One occassion still influences the way farmers regard their leaders. In the late sixties and the early seventies, the Shanbogues from both Baraka and belonged to the same Brahmin. This family owned a a lot of land in the commandarea. This means that they ought to send quite a large number of workers for communal maintenance activities. However, as some farmers stated one day the shanbogue from Gatlagollahalli refused to contribute his share labour input and that he sufficed by standing on the bund and making comments. It was said that the shanbogue even refused to pay the fine. Many farmers forced the canalleaders (all from the dominant Vokkaliga cast) to oppose the shanbogue, but none dared to punish a member of the Brahmin family. Out of discontentedness more and more farmers defaulted and refused to pay fines. Gradually the cooperation among the farmers vanished. Today, in Gatlagollahalli, every caste tries to bring forward its own canalleaders, who will guarantee that own castmembers will be favoured at times of waterscarcity.

We did not examine the stratification of the Baraka- and the Gatlahalli communities in depth. However, some examples might explain the better cooperation among farmers who maintain the left cannal. Whereas the caste division of Gatlagollahalli is diverse (see 6.1), the inhabitants of Baraka and Gatlahalli mainly belong to the Vokkaliga cast. So there are no leaders from other castes who want to take over the responsibility over the maincanals. The present leaders still do their duties and fully cooperate in communal activities. The shanbogue's son of Baraka still owns many fields in the commandarea, in contrast to the former shanbogue of Gatlagollahalli. In our opinion the first one is still interested in labour mobilization as it directly effects his economic position. The Brahmin family from Gatlagollahalli more an more neglects agricultural work and concentrates his attention on the political scene, which also changes the role of leadership in Gatlagollahalli (8.6.5).

8.4.6 The illegal appropriation of communal land- and watersources

Introduction

Waterscarcity, forces farmers and landless to search for alternative ways to manage their resources in order to guarantee a living. All these alternatives are found within the margin of decision making which is defined by local management rules (in the case of tank irrigation), the executive administration (PWD a.o.), the local and regional self-government and the local, village powerstructures. As the water availability is still decreasing and access to alternative watersources is limited, other, illegal, alternatives are found. We describe two examples.

1) Increase of the commandarea through encroaching
Officially the total commandarea is about 65 ha. After detailed survey of the records it appeared that about 10-15 ha. of wetlands are encroached. This means that the overall wateravailability per farmer, per ha, decreases. Unfortunately the distribution of scarce water is not based on equity: those who encroach wetlands take water from the tank which they are not entitled to. This severs the drought problem for others. These

encroachers have drylands adjoining the commandarea. They convert their drylands are converted into wetlands by branching the maincanal and levelling the fields to adjust them to irrigated conditions.

These farmers never got a permit to use the tankwater. Watercharges are not paid. Among the encroachers we found two groups in particular. The first group consists of the most powerful sections within the three villages: the Brahmin family, canalleaders and large farmers. Of course these can be represented by the same farmer or family. A member of the shanbogue family, who is both canalleader and large farmer, found the possibilities to favour his family to the disadvantage of others. Beside this family, farmers appointed all canalleaders as encroachers. At the right canal the canalleaders are able to encroach wetlands, because of the discommunication among the canalleaders themselves. At one occasion a canalleader stole water from the maincanal. No other leader came forward to fine him. But other villageleaders and villagers opposed. Hence, more than the canalleaders, the village as a whole has power to control the irrigationsystem.

The second group of encroachers consists of scheduled castemembers at tail-end. Although they all have small plots of wetlands, the total encroached area is still considerable. This group, whose position in general is very marginal, derive sufficient social power from their legal `underdog status' to preclude actions from other sections. Their emancipation is strengthened by government programs which aim at the alleviation of the position of scheduled casts and tribes. We found that other farmers were very reluctant to oppose to sc-casts and sc-tribes, as these people often enjoy considerable political patronage (see 5.2).

2) Stealing of communal watersources
In times when the river falls dry, the drawing of water from the communal riverbed immediately effects the groundwater table. After digging a pit in the riverbed, the groundwater can easily be reached and pumped out. Only one powerful canalleader was able to do so. The groundwater table fell back due to overpumping. As a result nearby marginal farmers with manual wells, experienced drying up of their wells.

A second example of illegal use of riverwater was found at tail-end. Some decennia ago the Public Works Department constructed a water 'pick-up' across the riverbed. Behind this pick-up the surplus riverwater is stored as is the case with a cross regulator. Consequently the watertable in the river raises and water can be taken from the river in order to irrigate some fields at tail-end. In the dry season hardly any water is taken as such. But one medium farmer found a possibility to take water from behind the structure by means of a syphon. He transported the water to his own fields. A last example we found was the individual pumping of water from the communal tank by means of a removable diesel-pump. Even before other farmers could get access to tankwater, the water was pumped out by a large farmer.

8.5 The Socio-economic Dimension of Drought in Kanithalli

8.5.1 Collapse of communal tankwatermangement

With communal efforts it is possible to exploit stored surfacewater in a sustainable way. In Gatlagollahalli we saw that the exploitation of tankwater still benefits most wetland farmers at times of monsoon cultivation. However, in times of water scarcity those farmers with individual access to alternative technologies of water exploitation prefer groundwater-exploitation above communal tankirrigation. This causes a severe underexploitation of springwater at the cost of the weakest sections of the village. The Gatlagollahalli example shows us the importance of organisation and communal participation in local resource exploitation. Social conflicts, whether or not induced by external impulses like government policies, will weaken the firm base of organisation. In 8.2.2 and 8.3.3 we noticed total under-exploitation of tankwater and severe overexploitation of groundwater. In this chapter we elaborate on the socio-economic dimension which determines the environmental conditions in Kanithalli.

We can be very brief about the organisation of tankwater exploitation in Kanithalli, as most of this organisation already disappeared. Of recent years, only in 1982 some tankwater was used through communal distribu tion, as at that time the tank was completely full; there was even an overflow of water. Some farmers thought it viable then to irrigate some paddy.

There are no official canalleaders left. All farmers say that at present all decisions with regard to maintenance of the system and distribution of tankwater will be taken by the Panchayat Members. One sc-family still bears the title of 'Neerganthi-family'. In the past decades seven members of this family took turns in the duties of neerghanti. But the family itself neglected their duties of bund-and canalcleaning (cutting of pongamia bushes) and the proper exploitation of their inamlands under the tankbund. The latter caused severe waterlogging and the destruction of the main-canal along these lands. Some wetland farmers complained about the neerghanti's indifferent attitude towards maintenance. They constructed a new canal which split up the inamlands. Only recently,after 16(!) years, the neerghanti more or less decided to take action against those farmers for using his lands. This indifferent attitude is perfectly illustrated by the fact that the neerghanti is using the rod of the outlet-locker to support the roof of his house.

It is evident that there is no communication between farmers and leaders. Those few farmers who still want to benefit from tankwater try to get access to it by own effort. These are the farmers who have have lands just under the tankbund, so they can benefit from seepagewater. The neerghanti's describtion of the attitude of the farmers towards the leaders in charge of tankirrigation shows the total lack of traditional respect towards village officialdom:

> *"As the shanbogue grows waterconsuming eucalyptus in the commandarea, he is not able to pay me in rice or fingermillet. But who can eat from eucalyptus? So I told him if he is not paying he won't get water anymore to irrigate his fields in the commandarea. If he*

wants to give me up to the police, let him do so! I am not affaid of the shanbogue, nor of the police!

The shanbogue used to be the most powerful person of the village. He even possessed about 12 ha., of which a considerable part in the commandarea.

8.5.2 Waterscarcity and access to water

With the disappearance of surfacewater exploitation, the importance of access to groundwater exploitation increases. As a result of the negligence of tankwater irrigation, there is constant waterscarcity in the commandarea, as no wells can be constructed in those fields (8.3.3). In Kanithalli access to groundwater depenends on:

a) Ownership of land and location of the fields within the total watershed. In 8.3.3 we saw that the most suitable places are those around the commandarea. The worst places are those in the former gomallands, because of increasing depth of the water tabel.
b) access to finances and knowledge in order to construct or deepen (bore)wells.

In Gatlagollahalli we found that the inequality in landownership was not dramatic different, real inequality became apparent when the discriminate distribution of access to well-water (see fig. par 8.4.2) was taken into consideration. Fig. 8.19 shows the distribution of access to (well-irrigated) lands in Kanithalli.

Fig 8.19 The distribution of land among different categories of landownership in Kanithalli, 1987

Category	average ha.	dryland %	wetland %	well-irrigated %
Landless	0.08	100 %	0 %	0 %
Marginal	0.49	92 %	8 %	0 %
Small	1.73	43 %	12 %	45 %
Medium	2.13	44 %	16 %	40 %
Large	3.73	25 %	25 %	50 %

Source: Village Accountant of Kanithalli

As the use of the drylands and the commandarea in Kanithalli is very marginal due to severe degradation, all attention is concentrated on the possession of the well-irrigated lands.

Landless and Marginal farmers

The demographic composition of Kanithalli shows that a considerable part of the village population belongs to the sc-caste (see 6.3). Untill recently those people did not possess land at all. Due to the 'Land to the Landless' schemes most households were granted one acre of Gomal land for individual cultivation. Due to lack of sufficient additional means like tools and bullock-cards, most sc-caste people are hardly able to manage the, already degraded, drylands. Some have to sell their lands or use tools- and cattle loans to repay former debts. Looking at table 1, it

is not surprising that the (former) landless do not possess wells: their fields are all in the Gomal area, the highest part of the watershed. They do not have the assets to invest in well construction. However, some farmers intend to from the cattle loans in order to invest borewells. Allthough they realize that they have to bore up to 120 meters, they regard groundwater exploitation as the only remedy. A few marginal farmers possessed wells, but due to the dramatic fall of the groundwater tabel all wells dried. They lack further access to finances in order to deepen those wells.

Small and Medium farmers

Besides the size of landproperty there is hardly any difference between small and medium farmers. They all are forced to construct new wells or deepen existing ones. Small farmers have to take bankloans; some take loans from big landlords. Most medium farmers have sufficient own means to invest in further groundwater exploitation, or they use cattleloans for this purpose. The only way to maintain cultivation is found in investment in borewells. Most farmers believe borewells to be the solution to their problem of water scarcity. But uptill now no one has been succesfull in the construction of a borewell.

Large farmers

Although large farmers still possess drylands and fields in the command area, they have to concentrate on groundwater exploitation to make former investments in mulberry- and grapegardens profitable. In the drylands (even in the commandarea!) they only grow some eucalyptus, as they consider these trees as a profitable and little labour consuming cash crop. All large farmers own 2 or more (even 5) wells, all very close to each other. As deeping of open wells is limited due to the rocky sub-surface, more and more large farmers invest in borewells. Only few succeeded in finding hydrological viable spots. Even with the help of a hydro-geologist and local rhabomancers many borewells failed to give sufficient water. Those who succeed totally rely on the bores, which sometimes even have ten outlets.
The construction of a borewell may cost more than Rs.10,000=, exlusive the pipe connection between the outlets. But the farmers keep on trying, as they consider it their only alternative left to get income out of agriculture.

8.5.3 Drought and irreversible marginalisation

In 8.5.2 we noticed a highly discriminate access to groundwater to relieve drought problems. Drought in Kanithalli hit landless and marginal farmers in various ways:

a) they lack the opportunities to construct or deepen their wells because of their lack of access to finances and suitable (hydrological viable) fields.
b) the high attention given to garden cultivation and unsustainable eucalyptus cultivation in the drylands by larger farmers, degraded other natural resources like the commandarea and the drylands. This will further decrease the possibilities for landless and marginal farmers to gain income out of other resources than groundwater.

Also small and medium farmers can hardly survive with the present access to natural resources. Their open wells dry up dramatically and they lack access to groundwater by means of the necessary borewells. The only category which seems to profit from further development of groundwater exploitation are the large farmers. However, in Kanithalli also large farmers are liable to the proces of marginalisation. Also their only alternative resource which may relieve their drought problems reaches its end!

In 8.4.3 we discussed the socio-economic dimension of groundwater exploitation[1] and its relation to environmental stability in Gatlagollahalli. In Gatlagollahalli yield stability and environmental stability through groundwater exploitation can only be achieved when all natural resources are managed in a sustainable way. But due to discriminate access to groundwater, tankwater exploitation and dryland cultivation seem to be underexploited. Underexploitation, to the cost of those villagers who are totally dependent on these resources. Whereas in Gatlagollahalli dryland and commandarea cultivation is still possible, it became impossible in Kanithalli.

The secured crop stability, achieved through communal tankwater exploitation and the cultivation of traditional cereals and vegetables in the drylands, have been replaced by highly profitable (see 8.4.3) cashcrop production through well-irrigated garden cultivation. At first this seems very profitable for those people with access to groundwater exploitation. However, due to the process of decreasing environmental stability also larger farmers are threatened by severe overexploitation of groundwater. Putting all attention to groundwater exploitation caused unsustainable exploitation of all the natural resources of Kanithalli. Irreversible degradation of the drylands, forests, wetlands and, soon groundwater sources already marginalised the position of the weakest sections of Kanithalli, but will in the end also affect the economic position of medium and large farmers.

Dependency on various resources (like in Gatlagollahalli) can be replaced by total dependency on one alternate resource (like in Kanithalli). Further degradation will change the social and economic structure within the village, as people have to look for other means of income generation. In chapter 7 we already discussed the way villagers cope with the changing output from various natural resources. In this chapter we give one example of changing relationships due to the development of mulberry production. The production of mulberry is induced by the pretended advantages of groundwater exploitation to relieve the drought situation in Karnataka.

The introduction of wells joins the introduction of cashcrops like mulberry and grapes. Mulberry, a very labour consuming crop, can be harvested six times per year. Studies show that there is no doubt that the increase in cocoon production during the recent past is not a result of the expansion of the area under mulberry, but it appears that the increase has taken place as a result of a remarkable improvement in the

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[1] An extensive evaluation of the economics of well-irrigation and the changes in labour application due to the transformation from rainfed- and tank irrigated cultivation in Karnataka, is given by N.D. Kamble(1979).

mulberryproductivity. The increase in productivity is due to, a.o. the expansion of the area under wellirrigation (ISEC, May 1981:19). Ha Nagaraja Rao states that sericulture is gaining momentum especially in the rural areas, because of, a.o. the following advantages:

1) irrigation facilities: the requirement of water for mulberry is 30% as compared to paddy.
2) average income per acre will be Rs. 800 under irrigated conditions and Rs. 300 under rainfed conditions.
3) sericulture plays a vital role in transferring wealth from the richer sections of society to the poor; the major share thereoff goes to the farmer who rears silkworms and produces cocoons.
4) family labour could be safely involved in the production.
   Source: Ha Nagaraja Rao,year unknown:2.

This makes clear that with well irrigation an increase in income can be brought about. This kind of income generaton may compensate the loss of income due to water scarcity in the drylands and the commandarea. With (assumed) little efforts tankirrigation can be replaced by well-irrigation. But none of these studies critically show how these benefits out of groundwater exploitation and sericulture are distributed. It may be argued that the opportunities for landless to work as a agricultural labourer in the gardens of a landlord will improve. But who actually are these landless? They may be those people who are excluded from access to newly exploitated groundwater sources and, consequently (as in the case of Gatlagollahalli), also from traditional tankirrigation which makes the management of own fields uneconomically. In the case of sericulture it is stated that family labour could be easily involved. Traditionally women are not involved in the irrigation activities[2]. But women are involved in the transplantation of seedlings, weeding and harvesting. For this reason women are also effected by drought (see chapter 7) and the introduction of new irrigation-technologies, as it influences croppingpatterns (see 8.3.5). It is our opinion that the involvement of women, and even children, into cashcrop production is very questionable as it does not really strenghen their position. It will only burden the tasks of women without really changing the social relations within the households. Besides the extra burden, women still have to perform tasks like fuelwood collection and grazing the animals (see 7.4). Women themselves are not directly getting more access to watersources. Although women are basically hit by droughtproblems, they are not directly involved in solving droughtproblems. They still depend on the way their husbands, brothers or fathers intend to cope with drought.

[2] Waterdistribution, systemmaintenance and so on.

8.6 DROUGHTRELIEF, POLITICS AND PUBLIC ADMINISTRATION

8.6.1 Local drought relief activities

The individual and group attitudes towards drought can not be regarded as solely autonomous, but are embedded in a wider political environment. In this section we will point out how local natural resource management is determined by politics and public administration. Firstly we will describe which efforts really take place in Gatlagollahalli and Kanithalli. To understand the villager's undertakings (or the lack thereoff), in 8.6.2 and 8.6.3 much attention is given to the wider scope of politics and public administration. A key to proper waterexploitation- and conservation lies in the excecutive powers of several departments engaged in droughtrelief (8.6.4). To what extent a role can be played by the recently introduced Mandal Panchayats is discussed in 8.6.5.

Droughtrelief activities in Gatlagollahalli

Like most, small indigenous communal irrigationschemes in Karnataka, also in Gatlagolahalli the organisation of water distribution and maintenance of the system is in the hands of the community itself.
Construction and rehabilitation of the main works of the tankbund, however, is done by the Public Works Department (PWD). The interference in problem solving, however, is marginal. Only at times of bund breaches the ex-officio leader of Gatlagollahalli applies for an official. In july 1987 when heavy rains filled the tank very quickly, thereby causing a breach the Junior Irrigation Officer reacted very prompt by arriving the same night itself.

Several times the beneficiaries of the tank requested the PWD for bundraising. The request was supported by the present chairman of the Mandal Panchayat, who also owns land in the commandarea. Eventhough he mobilised a relative, a Ministers of State, the request was denied. The farmers themselves raised the wasteweir with 0.5 meter. In the early seventies the PWD constructed a bund to protect the right springcanal from siltation, but the bund got washed away by the first heavy rains. Desiltation of the tank has never been taken up, as it is very expensive.

The Department of Mines and Geology interfereds even less. Only a few farmers asked for a survey by a hydrologist. However, most farmers consider the construction of wells as a private decision. Their decisions depend more on local knowledge of the rocky sub-surface, on the results they see from neighbouring wells and on the opinion of the rhabdomancer, the 'Thodipujarappa'[3].

The role of the Department of Soilconservation is very minimal. No real waterconservation measurements in the drylands were introduced. On a very small scale, in the lower, flatter(!) areas some farmers were assisted with the construction of terraces. The Agricultural Assistant, who is in charge of local agricultural extension, mainly emphasizes the productioncapacity of HYV's. No attention is given to special drought resistant species or mixed cropping to minimize yield risks due to drought.

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[3] One farmer asked for the help of a geologist. However, the (bore)well failed. Also rhabdomancers were positive about future results. Still there is no water from the bore

The Block Development Officer has local responsibilities with regard to Integrated Rural Development Programs. The programmes which have been initiated in Gatlagollahalli mainly focus on employment issues. Unfortunately these programmes lack a drought relief component. Sometime, solutions for the the increase in demand for employment are sought in such employment schemes like the construction of new tanks. No attention is paid to the potential positive and negative environmental impacts of such employment schemes (8.6.3).

Droughtrelief activities in Kanithalli

All solutions to solve drought problems concentrate on further exploitation of groundwater. The financial assistance for wellconstruction is bound to certain preconditions like the minimum distances to neighbouring wells (8.6.4). Due to overconcentration of wells, every new well falls far beyond these preconditions. Hence the Department of Mines and Geology does not assist in access to loans. As a result the exploitation of groundwater becomes a private matter.

The PWD started desiltation in the season of 1979-80, but they stopped the work as soon as the monsoon started. The work has never been completed. In 1984 the PWD constructed bunds at places where streams enter the tankbed to stop siltation. Some farmers say that these bunds are constructed to stop further encroachment of the tankbed. Bundraising never took place.

8.6.2 Droughtrelief and Executive Administration

The development of tankirrigation

Historical records give ample evidence that for centuries tankirrigation takes place. But what value has been given to tankirrigation as a mean of sustainable management of surfacewater? M. von Oppen and K.V. Subba Rao (1987:8-11) give some factors that influenced tankirrigation. To that we wish to add the following comments:

a) Physical conditions.
   It is our opinion that the aspects are only mentioned as long as the environment shapes sufficient physical preconditions to extract output from it. Tanks are only seen as a means of production.
b) Population density[4] and food productivity.
   Also here the output per acre, or per capita, is used as a main criterium of tankwater exploitation.
c) Abolition of fuedal land tenure relations.
   Soon after independance decreased the effectiveness of water controle and tank management.
d) The development of wellirrigation.
   Which made wellirrigation more actractive as an alternative, privately owned source of irrigation. Again exploitation is only regarded as a economic viable way of income generartion. Further more it needs less state investments than tankirrigation.

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[4] Tankdensity increases when the population crosses 60 persons/km. and reaches the maximum with a population density of around 220 persons per km., in the princely States.

Most striking about these factors is the neglect of sustainability of tankirrigation on the long run in relation to the short term bias towards economic benefits. We already discussed the environmental effects of tank irrigation, being a component of the total watershed. There are beneficial environmental effects like the increase in groundwater table, soilretention and accumulation in the tankbeds. These effects should get main attention in the intergrated development plans, as e.g. in the execution of the Watershed Development Programs. Nevertheless the attention of rehabilitation of tanks is still very minimal. M. von Oppen et al.(1987:19) give some explainations of the reluctant attitude of the PWD towards minor tankirrigation.

- decline of effectiveness of local tankirrigation management, which stresses the responsibilities and executive tasks of the Irrigation Department itself. Hereafter some remarks are given on the departments' attitude on local knowledge and potencies on sustainable management.
- other departments neglect soilconservation and afforestation in the catchment areas. Consequently the tanks get too easily siltated, which makes tankirrigation not profitable. We will discuss the coordination between the departments in detail.
- the cost of construction of new tanks and their maintenance[5]. However the remarks can only be made when the costs of new tanks are compared with maintenance cost and benefits from old tanks or with executive cost of dryland conservation.

Minor Irrigation and local management
The Irrigation Department is considered as a autonomous department within the Public Works Department. It consists of three wings: Major,- Medium- and Minor Irrigation. According to fig. 8.20 the Irrigation Department, Revenue Department and the village have their own responsibilities with regard to tankirrigation.

Fig. 8.20 Responsibilities on irrigation tank management in Karnataka.

Command area	Irrigation Dept.	Revenue Dept.	village
< 4 ha	not applicable	revenue collection	maintenance, repair, and distribution
4-80 ha	maintenance and repair, supervision of water regulation	revenue collection	water regulation under supervision
> 80 ha	maintenance and repair; water regulation	revenue collection	not applicable

Source: von Oppen et al, 1987: 31

[5] The total cost of construction vary between Rs. 4,300 and Rs. 16,700 per ha. The costs of maintenance are estimated below Rs. 20/ha./year.

In Gatlagollahalli the distinction between indigenous-communal and bureaucratic-communal irrigation has historically been made. Prior to 1966 the entire responsibility of managing irrigationwater was vested with the Revenue Department, which was (with the help of the village Patel and the Neerghanti) used to ensure a steady supply of water. The position of Neerghanti was a honarary one. They were alloted with inamlands in return for their services to the community. They were also paid in kind. The Neerghanti was very much part of the community itself. They used to reside in the village and they supplied water to farmers in accordance to the water demand of the farmers involved and the directives of the Revenue Department, represented by the Shanbogue.

From 1971 onwards the responsibility for watersupply has been entrusted to the Irrigation Department. With regard to already existing irrigationschemes with a commandarea of 80 ha. or more, the Irrigation Department finds it more viable to appoint 'soudi'. The soudi is a waterman who is paid by the government and who received some training. In some cases the soudi does not live in the village itself. For smaller commandareas, like the one in Gatlagollahalli, Neerghantis are not replaced by these officials.

8.6.3 Criticism on waterconservation policies

Neglect of local knowledge on waterconservation

Within the Irrigation Department there is a narrow attitude towards the local knowledge on management and conservation of tankwater. Existing minor schemes are neglected, as most emphasis is given to major and medium projects. Consequently hardly any attention is given to the local modes of sustainable watermanagement like, to a certain extent in Gatlagollahalli. If any attention is given, emphasis is mainly focussed around physical assistence. Local concepts of leadership, conflict management and communal people`s participation in resource conservation are not taken into consideration. We agree that in many situations, like in Kanithalli the social structure has eroded to the point of non-cooperation, but in villages like Gatlagollahalli there still exists a bases for sustainable natural resource management. Intervention without recornizing these realities will destroy all still surviving positive elements of communal resource mangement. Irrigation officials are often ignorant about the mutual benefits of shared responsibilities among village leaders, canal leaders and Neerghanti and other water users. Water is only supplied to those farmers who pay in kind to the neerghanti. In return the neerghanti is only paid when he guarantees a proper watersuppply to the farmers. This kind of mutal control is still effective in Gatlagollahalli. This is not to say that fuedal modes of supression and exploitation of the weaker sections of the village society by local leaders ceased to exist (see 5.1). It is questionable, however, whether the abolishment of the traditional authorities, like the replacement of Neerghanti by Soudi, will change such state of affairs.

The locally adapted knowledge on managing water deserves our appreciation, as it is often serves to the best advantage of the land and the long term survival of the community. An assistant Executive Engineer told us that it is better to take over the responsibility of all minor tanks to avoid further management problems in the village. It is questionable

however wether the Soudi may also cause the collapse of the indigenous system of waterdistribution. However an increasing number of Neerghanti are replaced by Soudi. We visited one recently constructed tankscheme where the Soudi was fired because of lack of money to pay salaries[6].

Environmental impact of Irrigation policies

The primary advantage of Minor irrigation compared to Major irrigation is that the irrigation facilities provided under Minor schemes can be decentralised as they are not contigent upon any single major source of surfacewater (Lalit K.Sen, quoted in B.S. Bhargava, 1980:14). In the seventies there was a certain increase in awareness about the importance of minor irrigation. But Fig 8.21 shows that much attention is still given to major- and medium irrigation.

Fig. 8.21 Area irrigated and the ultimate irrigation potential in Karnataka under major and medium and under minor irrigation(surface - and groundwater) (in 1,000 ha.).

	Ultimate Irrigation potential (1)	Area covered upto '85 (2)	(2) as % of (1)
Major and Medium project	2500	1285	51.40
Minor project	2100	1123	53.47

Source: Wamana, July 1986:6-7

To understand the integrated, conservation approach of irrigation development, the district plans 1987-87 of Kolar and Tumkur districts are given in fig 8.22.

It can be concluded that most attention is given to the construction of new tanks with World Bank assistence. Little attention is given to the restoration (desiltation) of old tanks and even less attention is given to flood control! However much more is done under the Drought Prone Area program (see 8.1.1) and soil- and water conservation[7].

[6] Compare the salary of Rs.13/day to the cost of construction of the specific tank: Rs.11,432 /ha..

[7] It is not made clear whether the latter is included in the Watershed Development Programs of the Dryland Development Board or not

Fig. 8.22 District plans 1986-87 for Kolar and Tumkur districts (budget estimated in Rs. 100,000).

	KOLAR	TUMKUR	KARNATAKA STATE
Minor Irrigation			
World Bank projects	85.18	33.33	1900
new tanks	11.15	11.80	211
restoration tanks	1.00	1.40	10
flood control	-	-	10
lift irrigation	-	0.50	100
construction and deepening wells	1.00	1.00	16
Agriculture	9.85	28.10	653
Horticulture	6.75	24.37	157
Forest	4.66	4.40	93
Drought Prone Area Projects	-	96.80	1163
Soil- and water Conservation	46.47	43.97	1016

Source: District Plans 1986-87, Karnataka State

The huge attention given to major- and medium irrigation schemes and groundwater exploitation compared to watershed protection has its impact on the environment. Huibers(1984:3) states that the traditional farming-systems which proved to be able to maintain the soil as natural resource, and making an efficient use of available watersources, have been replaced by systems that deplete it under presure of the need for more production. New management techniques are introduced without proper care or knowledge of their longterm environmental consequences. We saw ample evidence of in Gatlagollahalli and Kanithali where groundwater exploitation was introduced to relieve drought but, which at the same time, stressed the droughtproblems for others (see 8.4.3). For the construction of new tanks dryland cultivation and forest exploitation were lost as these lands had to be submerged to construct a new tankbed. An Assistant Executive Engineer expressed that the construction of new tanks is necessary to elevate the economical position of the entire 'region'. But he was not interested in the fact that for many villagers resources had vanished. Those who already own lands in the better, lower parts of the watershed are favoured at the cost of dryland farmers whose lands are submerged!

No Departemental integrated approach to droughtrelief

More than one decade ago B.B.Vohra (1976) stated that Irrigation Departments have traditionally been pre-occupied with the construction of big reservoirs and the main distribution system and are quite unmindful of what happens above the dam or below the outlet.

At present, in 1988, although some changes can be seen, these statements still hold true. As we have seen from the district plans, the sedimentation of reservoirs and the protection of structures from erosion are considered to be matters outside the scope of the responsibility of the Irrigation Department. Beside the necessary communication within programs

like the Dryland Development Program, there is no integrated watershed approach between departments. Also for surfacewater irrigation water harvesting and water consumption in the catchmentareas of tanks are crucial factors which should be taken into consideration. However, we found no cooperation between the Irrigation Department and the Department of Soilconservation.

On the other hand, as B.B. Vohra also states, it is not only the responsibility of the Irrigation Department. They are not the only ones who are to blame, also the Forest Departments provide lands as well as other sources to landless and small- or marginal farmers. The Forestry Department hardly looks beyond the confines of its own boundaries, though they can play a tremendous role in mastering waterconservation benefitting drylands, wetlands and groundwatersources and soils.

The Irrigation Department, surprisingly has never taken interest in groundwater exploitation. Although, under sustainable circumstances, it can mean a serious and important alternative source to surfacewater. Outside the Irrigation Department the importance of groundwater as a source of irrigation is increasingly being realised, favouring the increase of well construction. But the exploitation of groundwater is mainly a private business. Only the Department of Mines and Geology is able to influence to some extent the sustainability of groundwater exploitation. A geologist can notify an area where wells can be sunk. However he will only supply a certificate if the area is within certain limits[8]. Only with this certificate a farmer can get access to loans from the Primairy Land Development Bank. Yet there are no other means to regulate the groundwaterextraction (8.6.4).

To avoid negative environmental impacts (like e.g. in Kanithalli overexploitation of groundwater sources and underexploitation of surfacewater), an intensive cooperation between those who are involved in surface waterexploitation (farmers, Irrigation Department and Department of Soilconservation) and those who are involved in groundwaterexploitation (farmers, Department of Mines and Geology, Irrigation Department and the banks) should prevail. Only in this way it can be ensured that the replenishment of valuable resources is facilitated in every possible way.

8.6.4 Legislation and droughtrelief

Introduction

The key to proper management of natural resources lies in the effective use of adequat legal- and executive powers to undertake soil- and waterconservation activities and to restrict land- and wateruse so that these resources are protected and managed in a sustainable way. For Gatlagollahalli and Kanithalli this means that besides the restrictions of irrigation- and groundwater use, also the protection of lands in the catchmentarea deserves due attention. The importance of legislation is tested for two aspects, both invested in the acts:

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[8] E.g. in Kolar district these limits were: distance open well to next open well: 182 m.; open well to bore well: 250 m.; borewell to borewell: 250 m.; depth to groundwatertabel: before 1986 it used to be 182m. In 1987 it already was 250 m.

1) which are the powers and the responsibilities of the State government, the several Departments involved, officials, local bodies such as the Mandal Panchayat and the individual villagers, dealing with soil- and watermanagement?
2) which rules are used by the government in order to conserve watersources?

The answers to these questions lead us to our main question (see 2.1) about the role played by politics and public administration with regard to natural resource management. Local decision making and conflicts around watermanagement (8.4 and 8.5), as well as policymaking by the Government (8.6.1) are influenced by legislation, as legislation determines the margins of execution of resource management.

We will elaborate on three legislative instruments: The Karnataka Irrigation Act (1965), The Karnataka Groundwater (regulation and control) Bill (1985) and the Model Soil Conservation Bill (1955). To understand the lack of integration between the Irrigation Department, the Department of Mines and Geology, the Department of Soil conservation etc. (see 8.6.2), we need to look at rules which could stimulate the necessary kind of integration.

The Irrigation Act

'This Act makes provision relating to the construction, maintenance and regulation of irrigation works, the supply of water therefrom, obtaining labour in emergencies and other matters pertaining to irrigation in the State of Karnataka'(Karnataka Irrigation Act, 1965).

Well construction

The construction, control and maintenance is conserted by the Government, who is of the opinion that it is in the interest of proper irrigation to control the construction of wells in commandareas. For Gatlagollahalli and Kanithalli this means that no one is allowed to construct wells in the commandarea or within 150 feet (46 m) from the tank or commandarea. However, in both villages we saw a considerable increase of well irrigation in and around the commandarea. But who is actually responsible? According to the Act, the only person who may give permission for well construction is the Assistent Engineer of the PWD division level (see 5.4.1). Although all irrigation officers we spoke to, knew about the existance of such Act, no one was able to give the exact distances. There is hardly any control in the field.

The Department of Mines and Geology will give a certificate under the condition that a minimum distance of the proposed well to other wells and the groundwater table is regarded (see 8.6.2). However, no restrictions are made with regard to the position of a well to the commandarea. The Irrigation Act regulates to a certain extent the exploitation of groundwater in order to protect surfacewater sources, but we observed the absence of control in the field. No reference is made for instance to the Groundwater Bill). The uncertainty about who is responsible for the execution of control will stimulate overexploitation of groundwater at the cost of underexploitation of surfacewater.

Tankwater conservation

How does the Act regulate the protection and sustainable management of communal irrigationwater? No person but the Executive Engineer (district level,see 5.4.1) may interfere with or divert the course of a natural stream or construct bunds, weirs or any channel or stream flowing above or below any fieldchannel. Nor is any person allowed to obstruct the proper functioning of drainage works such as the use of weirs or syphons. When it appears that there is injury to any land from any obstruction of natural streams, the obstruction may be removed by the Super Intending Engineer (regional level). Of course these rules include the branching or tapping from canals and the tapping from natural streams and communal irrigation works. Hence, land- and water encroachment In Gatlagollahalli (see 8.4.3) form examples of the violations of these rules. But at local level, in the field, we never saw measures taken by the Super Intending Engineer, nor by the Executive Engineer. The officer who is mainly applied for by the farmers themselves, the Junior Engineer (taluk level) has no powers or duties in respect of irrigation works under the provision of any of these rules. Lack of control and regulation at local level leaves the problem of encroachment to the farmers themselves. We already saw (8.4.3) that this leads to control of scarce watersources by a small group of farmers, causing severe loss of access to tankwater by the majority.

Other rules

The Assistent Engineer has only the jurisdiction over the excavation of new wells and the requisition of labour for urgent works like the repair of dambreaches to save water. The jurisdiction over all other rules are in the hands of higher officers. The supply of water will be stopped in case that a fieldchannel is not maintained in such a manner that it prevents the wasteful escape of water or the misuse of water. Another possibility to preserve watersources is that the governemnt has the power to prescribe the kind of crops to be grown. However, such official measures were never employed in Gatlagollahalli or in Kanithalli. Control over crops is vested with the Revenue Department, represented by the Village Accountant (5.4.2). It is the duty of the Village Accountant to inspect and prepare a statement about each surveynumber (plot) to which water is supplied and to inventarize the crops that are grown in order to specify waterrates. Every season he has to inspect every field. Adjustments of these rates can be made, depending on the crop, season or of watershortage because of drought.

Flood protection

If necessary, the official policy makes provisions for drainage works to improve the proper cultivation and irrigation of any land and to protect the land from floods caused by erosion. Though in Gatlagollahalli and Kanithalli there is the danger of overtopping the wastweir (farmers increase the heighth of the waste weir in reaction to the increased siltation of the tank) (see 8.2.2), hardly anything has been initiated to prevent wasteful use of tankwater. The laws do not mention anything with regard to the protection of irrigation works from erosion. Tanks, springcanals and drainageworks are damaged by the increase in erosion from the catchment area. Appearently the responsibility to undertake measures against erosion are shifted to those Departments which are dealing with

the conservation of catchmentareas. The Irrigation Act gives no directions about duties and responsibilities of the Irrigation Department with regard to protection of irrigation systems from erosion.

The Groundwater Bill

The Karnataka Groundwater Bill (1985) provides better regulation of the extraction of groundwater and the prevention of waste of groundwater and allied matters. It is not made clear for which type of usage of groundwater this Acts counts: only "domestic use" is mentioned, but there are no references to exploitation of groundwater for the purpose of irrigationwater.

The State Government has the power to regulate the extraction of groundwater. To sink a well an individual farmer has to get a permit from the Groundwater Authority. However the Groundwater Bill does not mention the specific tasks nor the role, authority and powers of the Executive Engineer (PWD), nor the limits given by the Department of Mining and Geology. It remains unclear who really is in charge of the regulation of groundwater exploitation. In Karnataka we found that depends on individual decisions of farmers. Because of lack of communication between all parties involved the enormous increase of groundwater exploitation can continue without proper regulations at the cost of other resources and at the cost of those whose survival depends on the access to natural resources.

Soil- and Waterconservation Acts

Also the protection of the catchment is important to guarantee tankwater- and groundwater supply. However, as far as we know there are no Acts which deal with the protection of catchment areas. Karnataka enacted soil conservation laws subsequent to the Model Soil Conservation Bill (1955) (A. Jacob, 1982: 155). The issue of legislation for watershed management may also be examined with reference to forest legislation (7.10.4). In the existing State Acts the approach of dividing watersheds in subwatersheds is almost lacking (A. Jacob, 1982:155). However, the initiatives of the Dryland Development Board to an integrated, physical approach give hope for the future. It includes, among others, an institution which consists of members of different Departments and members of different consultative institutions and universities and that is authorised to execute the objectives of proper watershed protection.

Some Conclusions

The rules within the Acts are far from sufficient: hardly anything is said about the integrated regulation of conservation and sustainable management of watersources. Powers and responsibilities are mainly vested within the Departments, but higher officials do not control the rules at local level. The absence of control and executive powers of local bodies leads to a situation of the 'survival of the fittest", causing extreme overexploitation of surface- and groundwater. There are strong arguments to support a shift of powers and responsibilities to local institutions manned by the farmers and landless. This may augment peoples involvement in the conservation of resources as in such a situation they themselves are accountable to their fellow villagers.

In the past this was done by means of the Panchayat Raj institutions. The Village Panchayat and Local Boards Act (1959) mentioned the powers of these bodies with regard to tankirrigation, but history learns that the executive framework only remained on paper. New initiatives are taken with the introduction of the Mandal Panchayat. In 8.6.5 we will elaborate on the possibilities of the Mandal Panchayat to have autonomous powers and to dispose over funds. We also discuss which Departments, like the Irrigation Department, may waive some of its powers and responsibilities in favour of local bodies.

8.6.4 Participation and Droughtrelief: role of the Mandal Panchayat

A review

In previous paragraphs we discussed drought problems, their causes and consequences, from different point of views. It is stated that drought not only occurs because of climatological changes, but also by severe underexploitation of existing surfacewater sources (tank and springcanals) and increasing overexploitation of alternative watersources like groundwater. Unsustainable management of the agricultural drylands has led to erosion and consequently to decreasing water storage capacity of dryland soils and severe siltation of tanks. In section 8.4 and 8.5 we emphasized the social context of these changes in management of watersources. It is showed that the changes in watermanagement, and hence the way farmers cope with droughtrelief, also can be partly explained by the disturbance of social relations which determine the agricultural productionsystem. In Gatlagollahalli the changes of leadership, patron-client relationships, political factions, cast relations and so on caused further decline of mutual cooperation and set going the individualisation of management. In Gatlagollahalli communal tankwater management more and more is replaced by individual well-irrigation. In this case the decline of communal management, the neglect of system maintenance, the robbing of other watersources and further introduction of well-irrigation lead to the degradation of tank- and groundwater and of natural resources. Moreover, the change in watermanagement causes marginalisation of those groups that loose control over 'traditional', communal natural resources and can not find access to alternative resources. The latter, most extreme case can be found in Kanithalli.

It is the aim of our study to analyse the role of politics and public administration in determining villagers decisionmaking with regard to natural resource management. In 8.6 we discussed the shortcomings of policymaking and legislation and how they influence local resource management. An important aspect we focussed on was the governments perceptions on indigenous landuse-systems, the technology used within those systems and the way local decisions are made through community participation.

Community participation

In this paragraph we will further elaborate on the problem of communication between bureaucracy and villagers. In both villages we noticed a lack of interlinking mechanisms of responsibility and authority with regard to natural resource management. Local people show a lack of reluctance to rely on the competence of bureaucratic executive agencies

as they are afraid to loose even more control over their resources. Farmers told us that every governmental interference has led to less access and control over their resources. Gomal land and forest is protected and exploited by the Forest Department, the PWD takes the benefits from roadtrees. etc. The only natural resource they still have fully access to, is tankwater. But on the other hand they blame departments not to be active on maintenance (bundrepair and desiltation). Bureaucrats tend to disregard the potential value of indigenous irrigationsystems and their potential in coping with drought.

In this situation the responsibility and authority over watermanagement are villagers' own hand. In Gatlagollahalli the community itself keeps control over tank- and springwater. There is only a scant role left for the PWD: in times of bundbreaches. In such situations villagers together with the Junior Engineer try to solve the problem. In Kanithalli no communal activities at all are undertaken to rehabilitate tankirrigation. The PWD is not interested in small scale irrigation and the villagers themselves do not want to cooperate anymore. In case that indigenous irrigation systems are neglected and eroded, large scale bureaucratic organised irrigation schemes are stimulated and/or new technologies of groundwater exploitation are developed. Villagers more and more loose their grip over natural resources. In the case of communal irrigation systems access to water depends to a great extent on local decision making and mutual benefit between leaders, the Neerghanti and other beneficiaries. Peoples cooperation is the main factor. In Kanithalli this kind of self-determination has been replaced by dependancy on bureaucratic decisions and access to markets. Studies show that further bureaucratization will lead to decreasing involvement of the farmers in communal watermangement[9].

In chapter 7 we noticed a change in governments perceptions with regard to peoples involvement in treeplanting; more and more the Forest Department (social forestry wing) agrees that re-afforestation can only be implemented through people's participation in decisionmaking and execution of programs. Now we have to ask ourselves whether further administrative, financial and technical powers can be decentralised to achieve more proper and sustainable ways of waterdistribution and system maintenance, in order to cope with droughtproblems on local level. To what extent can decentralisation of these powers shape preconditions for sustainable watermanagement like waterconservation, desiltation of tanks and avoid overexploitation of groundwater. Sustainable watermanagement, then, also includes equal distribution of water to waterusers and the equal share of burden of costs of maintenance and rehabilitation (after P. Blaikie and M. Brookfield, 1987:19[10])

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[9] Farmers participation research conducted by the Indian Institute of Management, Bangalore (Indian Institute, 1986).

[10] In their approach of regional political ecology they distinguish three different models and ideas surrounding the concept of margin and marginality; the economic concepts (in terms of a factor of production); ecological concepts (natural and man made conditions of resources to re-produce, and the question of environmental variability); political-economic concepts (socio-economic impact on people and their productive activities of on-going changes within society at local and global level). There is a close relation between

It is necessary to rationalise the degree of decentralisation by handling the criteria that the lower level officials involved should be sufficiently armed with powers to tackle day to day operational and maintenance problems (after: B.S. Bhargava, 1980:98). We saw in 8.4, in cases of waterloss by bundbreaches or the encroachment of land and water, there are no low ranking officials with sanctioning powers. Hence, there is a gap between policy making and supervisory framework at the higher level and the implementation of policies and the execution of controling tasks at fieldlevel. Politicians finally discover that the laws and rules they made are not adopted on local level. Consequently, most decisons and activities are taken by the farmers themselves.

Mandal Panchayat

In the past, but also at present, one tried to fill up the gap by the creation of local self-government institutions like the Panchayat Raj (see 5.1). Although the Village Group Panchayat embraced 5 villages, tank maintenance and watermanagement was only taken up by the beneficiaries of one tank[11]. According to B.S. Bhargava (1980:101) there is a widely shared believe among farmers that before independence the villagers were quite capable of desilting the tanks. Therefor it can be made an important task of the Panchayat Raj institutions to reinvigorate this kind of peoples participation in:

a) desiltation of tanks
b) the construction of siltdams in the tankforeshore and other soilconservation measures in the commandarea, such as afforestation of the catchmentarea to protect tanks from soilerosion
c) controle of local rules with regard to land- and waterencroachment, cultivation of tankbed- and bund, maintenance of the irrigation system and protection of the riverbed.

Although the Panchayats are regarded as the only democratically constituted institution at grass root level, lack of finance, technical competence and the reluctant attitude among farmers towards cooperation are severe constraints to the execution of panchayat duties.

The idea of panchayats is that they are used as a kind of 'communication centre' to channalise the needs and problems of wetland farmers to executive and consultative agencies like the PWD at district and Block level. The idea of the Village group Panchayat only worked on paper, but not in the field: nothing was undertaken by this Panchayat to rehabilitate communal tankirrigation.

A new attempt is made with the introduction of the Mandal Panchayat. Hence, high priority should be given to strengthening of communal watermanagement. In the Mandal Panchayat all tanks with a commandarea below

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these three concepts. In our opinion, in discussing models of marginality, sustainability and so on, environmentalists should always take these three concepts into account.

[11] Officially it was the PWD who had to streamline the organisation and administration. Tanks which had a commandarea of less than 4 ha. were, and still are, supervised by the Taluk Boards, represented by the Block Development Officer.

200 ha. come under the direct responsibility of the Mandals[12]. The financial- and technical assistance given to the rehabilitation of one tanksystem and the protection of the catchmentarea will now depend on decisions taken by the representatives elected from each village.

Some doubts and conclusions

There is a deconcentration of finances as more money can directly be spent on a lower level and there is also a partly devolutions of powers of higher levels to legally established and locally elected political authorities. But on the other hand we notice a centralisation of local decisions which ought to be taken: decision making will take place at the scale of 25 villages. Specific local decisions with regard to watermanagement will not directly be taken by only those farmers involved but by representatives of the village during the meeting of the Mandal Panchayat. Individual farmers more and more have to rely on those representatives in order to get access to tankwater and loans and assistence for groundwaterexploitation. This will certainly effect the individual involvement in a negative sense. We agree with P. Blaikie and H. Brookfield (1985) that resource management through peoples participation only is possible when every beneficiary directly is involved and knows that she/he can influence decision making. This can only occur when people trust new concepts. Even before the introduction of the Mandal Panchayat we noticed that farmers are very sceptic to such a large scale concept of local determination. Again they feel that something from 'above' is coming to them. They do not cooperate on a voluntary base, which should be the base of every kind of participation and cooperation.

The above also makes us very sceptical about the potential of direct watermanagement through the Mandal Panchayat. In our opinion the Mandal Panchayat can play a role as a institution which tries to sluice finances and assistence to the villages when necessary, but it certainly can not substitute local level decisionmaking and local maintenance with regard to tankirrigation.

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[12] Finance and technical assistance to the Mandal is partly channelised through the Zilla Parishads. This budget has to be distributed among the Mandal villages.

9 INTERPRETATION

9.1 ENVIRONMENTAL DEGREDATION

In diagram 9.1 an overview is given of all forms of environmental degradation. Also the different natural values (rarity, diversity, spontaneous functions (such as regulation of water-soil- and nutrientflows) and the various exploitation functions (extensive, like grazing and intensive, like cashcrop production) are taken into consideration. Taking all types of environmental degradation into account, it is the total impact of changes and the losses of values and functions which has to be discussed. Understanding of the biomass-flow (see 7.9) is the keyfactor to grasp the effects of all different demands like fodder, fuel, timber, green manure, fertile soil, surface- and groundwater. The more emphasis is put on the exploitation of one resource, the more it leads to the degradation of other resources. Decrease of one natural resource brings a growing dependancy on other resources. If local available resources are depleted, more inputs will have to be obtained from outside the local environmental system. Gatlagollahalli is a village which has many resources available, although they are often degraded. In Kanithall, however, many resources are depleted or even lost.

Gatlagollahalli:

Given its primary focus on staplefood production, animal husbandry, and the low availability of external inputs, biomass-flow of Gatlagollahalli can be depicted as closed. At present, the village is still dependent on locally available resources to support its agriculture and to guarantee basic needs satisfaction. With the decrease in acreage of common property resources like gomals, many components like fodder, fuel deminished. This has a direct negative influence on the quality of the agricultural fields: although forest products formerly supported the agricultrual fields in the lower parts of the watershed, these drylands and wetlands now mainly rely for their inputs on the biomass production of the gardens and wetlands themselves. Also the manure input decreased due to the vanishing of grazing grounds. The degradation of lands on the higher parts of the watershed disturbed the regulation of water and silt transport. However, farmers regard drought still as a decline in rainfall, although drought is much more an outcome determined by the actual misuse of available surface and groundwater sources. Erosion in the catchment causes severe problems of waterstorage in the drylands and hinders the recharge of groundwater sources. The waterflow, surface runoff to the tank gets disturbed and the waterstorage capacity of the tank has declined due to siltation. The increase in velocity of surfacewaterflow hazards overflow of the tank, which spoils scarce water. Besides, with the decrease of storage capacity the total waterdemand increased. However, apart from some problems at tail-end, the use of tank water is still sustainable. In fact, we found an incrasing under-exploitation of tank springwater. Also the exploitation of groundwater is still sustainable although overexploitation is expected in future due to further increase in the number of wells in and around the commandarea.

fIG. 9.1: Environmental problems in Gatlagollahalli and Kanithalli

ENVIRONMENTAL PROBLEM	GATLAGOLLAHALLI	KANITHALLI
Shortage of surfacewater (8.2.2)	*substainable exploitation of tankwater, allthough increase of waterrond and decrease of storage due to tanksiltation*	*severe underexploitation of tankwater*
	sore shortage at tail-end	*50% siltation of tank*
	underexploitation of springwater	
(8.3.4)	*decreasing waterstorage in drylands*	*hardly storage of water in drylands*
Shortage of groundwater (8.2.3; 8.3.2)	*sustainable groundwater exploitation, but stressing in the future*	*severe overexploitation*
sandheeps (8.3.2)	—	*construction and deepening of wells sandheeps which take production*
lost of water (8.3.1; 8.3.4)	*little change of tank reflow*	*severe hazard of overflow waterlogging at top-end*
decreasing yields (8.3.3)	*decrease of staplefood in Wl and Dl.*	*lost of staplefood in wetlands*
	sustainable dryland production (9.3.4)	*severe decreasing of staplefood in DL.*
diversity decreases (8.3.3)	*lost of gardens and wetland species*	*no gardens (inderous) left.*
fishey	*never taken place*	*totally disappeared.*
lack of regulation of runoff	*increase of peak discharge, but still regulation*	*no regulation or buffering of runoff water*
lack of regulation of silt runoff	*some soilconservation measurement*	*no facets which can conserve water & soil; only eucalyptus*
	still sore forest, but more replaced by eucalyptus	
	sustainable management of DL	*mismangement of drylands*
lost of gomaltrees/ (7.2/7.3)	*hardly gomals left*	*idem, increase of agriculture*
	increase of agricultural fields	*but within proper tree management*
	including tecdirional trees	*only some eucalyptus*
lost of forest (7.2/7.3)	*still some forest left, but decreasing quantity and quantity of species and treecover*	*no traditional forest available*
		bad management (cover, species,
		reserved forests
	lost of hardwood species	*well managed soil conservation in protected forest.*
lost of road trees	*still trees available*	*no trees left*
lost of wetland gardens	*garden trees left*	*no trees in wetland left*
	some trees and bush left	*all trees have been replaced by mulberries and grapes.*
no use of tankbed	*replanting of trees and little vegetation*	*no trees are planted*

no use of tankbed	*replanting of trees and little vegetation cover during dry season*	*no trees are planted*
no use of riverbed	*high coverage of fodder trees* *scattered bamboo; diminishing vegetation cover of smaller rala's*	*barren banks*
foddershortage (7.5.1)	*decline of straw from byproducts* *less fodder trees in wetland* *still some fodder trees* *fodder is heaviest demand on forests*	*more dependant on by-products* *more wetland fodder production* *no fodder trees in gardens and wetlands* *no fodder in drylands.*
livestock reduction	*less milk, less dung, fraction*	*more crossbred cows, more milk, more dung used for fuel.*
timbershortage (7.6.3)	*still timbertrees in drylands* *also some in wetland* *no hardwood species left* *no common trees left*	*no trees left: all wood has to be bought on markets.*
green manure shortage (7.7.1)	*still green manure in wetlands* *on prints trees and along roads* *decreasing availability in drylands*	*no green manure* *chemical fertilisers.*
no more minor products (7.8)	*still available and used, from forest*	*barely available or used.*
Fuelwood scarcity	*great diversity of fuel sources* *some use of agricultural waste* *main source: forest, but already some over-exploitation,* *no use of cowdung* *fuel wood also used for preparation of home-made products like oil.*	*little diversity available* *mainly agricultural waste* *no forest*
others	*loss of fauna* *loss of drinking ponds in froest* *loss of shade*	*idem*

Kanithalli:

The environmental situation in Kanithalli differs very much from Gatlagollahalli, irrespective the former similarities in physical conditions and landusesystem. Many sources have disappeared and consequently can not serve other natural resources. Fuel, artificial fertilizers and timber have to be extracted from outside the village. Outputs, extracted from the small forest on the riff are absorbed by outside industrial demands. The management and conservation of the drylands is neglected and the command area is out of production. All agricultural activities take place in the well-irrigated gardenlands surrounding the former commandarea. Mainly cashcrops like mulberry and grapes are grown. Keeping stallfed, crossbreed milk cattle becomes a specialized enterprise. Due to severe erosion the tank has siltated and the deterioration of the catchments caused an unreliable waterflow to the tank. Although less water percolates due to increasing run-off, there is a heavy increase of groundwater exploitation. Consequently severe over-exploitation of available groundwater sources is found. The available tankwater is hardly used, even some waterlogging occurs under the tankbund at top-end.

9.2 CHANGES IN PRODUCTIVITY

Processes of environmental degradation lead to a redistribution of resources to the disadvantage of the poor. As said, the two villages differ widely in terms of variety of natural sources. In Kanithalli an increasing dependency can be observed towards a few resources accessible to only a few categories of landholders, whereas in Gatlagollahalli a multi-variety of sources can (still) be found, accessible for several categories. Thus, the productivity of the environment is decreasing. However, with some of the resources still sufficiently available to fulfil their basic needs, people seem not to regard this as a major problem, even if there is a huge decline in quantity and quality of natural resources. Moreover, if these resources are already lost for a considerable period, villagers may have found alternatives. However, some of the resources can not be replaced due to a lack of access to private sources and/or a shortage of cash to buy substitutes. If we look at the categories of landholding families which make use of sources which are managed on a communal base (gomal, tankbed) and resources which are under direct supervision of the government (protected forest), it is evident that mostly landless are dependent on them for their basic needs fulfillment. Landless and marginal farmers favour from the availability of communal natural resources and from communal management systems (tankirrigation, tankbed cultivation). The convertion from pastoral to arable land under privatization certainly gave some of the landless a patch of cultivable land. However, their access to sources for fodder, timber and fuel diminished considerable. Without these resources, management of agricultural land is impossible.

Decreasing range of alternatives

Faced with the decline of productivity of the different land use types, each category has to find its own alternatives. Especially the poor suffer, as the common property resources are getting depleted rapidly, while no other alternatives are left. Moreover, those villagers with most access to alternatives (medium and large farmers) are also those which are able to withdraw from communal activities, which even more

effects the availability of resources for small and marginal farmers. Furthermore, the change from a multidiversified system like Gatlagollahalli towards a narrow resource base like what we found in Kanithalli has a direct impact on the life system of the villagers. Diversified systems generate more independent sources of income (cash) and basic needs (they offer more different sources of proteins and vitamins, thus improving health conditions. And then, a diverse resource base enables the villagers to avoid the risks which are bound to a more narrow resource base.

> Landless and marginal farmers in Kanithalli declared to be unable to harvest enough seeds from communal trees to produce 'sufficient' quantities of oil. Also they said that they were often forced to prepare less meals in order to save fuel. Cooking with inferior fuel increases the workload and effects health (more smoke).
>
> Drought reduces income from yield. The ongoing process of commercialisation undermines the sound long term oriented habit of farmers to store grains for meagre periods. People become more dependent on markets and, at the same time it decreases the diversity of species (fruits, vegetables, grains, mixture crops, sugarcane, bamboo) and hence endangers the basic needs supply, thereby influencing the quality of life and the state of health.

The above mentioned change in the land use system effects the socio-economic position of the poor also in the sense that it forces villagers to look for extra labour opportunities, often outside agriculture, which in many cases will be at the cost of other income generating activities like agricultural labour, cattle grazing, plates, ropes and oil production etc.
In landuse systems like in Kanithalli, where farmers totally depend on one watersource, the increase in drought (or less access to water, whether or not available) strengthens all kinds of dependency relations. Also marginal and small dryland farmers in Kanithalli become more and more dependent on labour opportunities offered by large farmers or they seek jobs outside the village.

Future development

The situation in Gatlagollahalli tends to go into the direction of the situation in Kanithalli: a increase of environmental problems and a decrease of alternatives to solve these problems leads to further social differentiation and causes the marginalisation of the poorest. Only leaders and large farmers have access to water. The number of labourers increases and the possibilities for villagers to get employment in agricultural within the village diminishes.

9.3 THE SPIRAL OF ENVIRONMENTAL DEGRADATION AND SOCIAL MARGINALISATION

As said, due to the degradation of the environment, rural people are forced to look for alternative income sources and basic needs supplies. These local activities aim at overcoming the consequences of the environmental problems but often cause at the same time other problems. We can distinguish different types of this role off process, for each of which we found different examples in the two villages:

1. **spatial** allocation: Exploitation of a specific natural resource causes unsustainable (over- and under-) exploitation of other resources.
   e.g. - When forests are depleted more wood is used from individual land or bought on the market (which pushes the problem to another area);
   - The actual attention which is given to groundwater exploitation leads to the neglect of the Dry lands.

2. **temporal** allocation: present solution will be a problem for the future.
   e.g. - the actual attention given to groundwaterexploitation may degrade wetlandfarming in the future due to overexploitation of groundwater and the vanishing of communal access to surfacewater.

3. **individual** problems are allocated to the **community**: natural resource exploitation benefits individuals at the cost of the community.
   e.g. - By trying to encroach water, less water is available for the other members;
   - Granting of gomal to the forest department and its distribution to landless for cultivation caused depletion of communal fodder sources.

4. **hierarchical** allocation: one individual or group puts the consequences of environmental problems on the shoulders of other individuals or groups indigenous powerstructures, When these communal powerstructures are replaced by individual decisionmaking and executive activities, all local regulation will disappear leading to overexploitation. This can be seen in Kanithalli and will also take place in Gatlagollahalli when no alternative strategies are developed.

Taking these different types of allocation processes in mind, we are coming to the concluding remarks and recommendations with regard to the central researchquestion.

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 INTRODUCTION

The general tendency to 'bank on the future' has brought Karnataka at the brink of an ecological crises. There is a real danger that the 'blessings' of the green revolution will be overtaken by growing Sahelian conditions. There is a alarming shortage of biomass and each year the grondwater resources in the Deccan are getting further depleted. The problems of deforestation and under- or overexploitation of waterresources have a far reaching impact on the general state of the villager surrounding natural environment. In foregoing chapters we described how water and biomass scarcity influence the chain of physical and ecological processes and how their distortion leads to a decline of soil fertility and ultimately to further soildegradation and to diminishing agricultural production. We found that especially fodder shortage is an acute problem in these areas and not the fuelshortage as is the general believe. Through the chain of physical and ecological processes this has a far reaching impact on the availability of other resources, not only in this area but also outside the village surroundings.

The individual farmer, who is faced with these problems of scarcity, is encouraged by several government programs to role off his problems on his neighbour and on the next generation. There is no sign that the government intends to do the necessary investments into alternative, more sustainable means of land use. The development of droughtresistant rainfed Dry Land agriculture and minor tankirrigation still receive to little attention.

Social consequences

As regards the social consequences: the environmental degradation effects the village economy in general. What we can conclude from our village studies is, however, that it is the poor's survival which is directly threatened. Villagers differ in the extent to which they can cope with the degradation of the natural resource base. This is mainly because they have different access to water, land and other inputs. As for instance in the research village Kantihalli, where there is a severe problem of groundwater depletion, but, where some farmers, because they have or can get the finances to invest in more intensive groundwater exploitation, often still recieve good revenues from high cashcrop yields. This in contrast to the alarming living conditions of most landless, marginal and small farmers. These villagers, who have but limited access to these resources, even face difficulty in fulfilling their daily needs in terms of food, fuel and fodder.

Though it is true that, partly as a consequence of the before mentioned reforms, the poor experience a social and political emancipation, they nevertheless remain economically dependent on the landowning classes. Because, the poor villagers can neither rely on the, mere incidental, official employment schemes, nor do they really benefit from the government's land-policies. The problem of landlessness and the need for landreforms is not taken up at such a scale that it can provide the landless with sufficient cultivatable land. There is a real danger that because of these developments, the position of the poor will further deteriorate.

Nowadays it can be observed that the landowning families show an increasing indifference towards their social obligations with regard to their fellow villagers. This change in social norms is mainly caused by the incorporation of the village in the wider political and economic system. It will be near to impossible for the government alone to compensate the poor's loss of economic security.

10.2 CAUSES OF ENVIRONMENTAL PROBLEMS

We found that the protection and maintenance of local natural resources often falls short of what is required to prevent their degradation. This lack of protection and/or maintenance can be translated as a problem of under- or overexploitation.

The break down of community participation

The breakdown of community participation is a major cause of the underexploitation of tankirrigation, which at the same time leads to a lack of maintenance of this irrigationsystem. On the other hand we see an increasing amount of farmers who invest in private well-irrigation. Here, however we have the worrying problem of overexploitation of groundwater. Uncontrolled overexploitation also caused deforestation in major parts of the village commons. Where villagers have free access to such grounds, indiscrimiminate felling and overlopping takes place. No investments are made and lack of protection and self-constraint among villagers hinder the regeneration of the vegetation-cover.
In Gatlagolahalli we observed that people are often forced to cut trees even from their own private land, because they need to raise money through the sale of wood or because they themselves need the timber or woodproducts from such trees. In general villagers start paying less attention to treeplanting, except for these villagers who grow trees as cashcrop.

State intervention

The collapse of community participation in natural resource management already started under British rule. Then the official policies aimed at an increase of revenues from agriculture. To that end further commercialisation of agriculture was encouraged. In addition, the British introduced a new system of revenue collection whereby farmers had to pay taxes, in cash, on an individual base (Ryotwari system). The commercialisation of agriculture and the new system of revenue collection led to the collapse of communal farming traditions.
The villagers also experienced how the state initiated the large scale forest exploitation which brought the destruction of their surrounding natural environment. The Forest Department or the contractors who hold official licenses, clearfelled the natural forests, leaving heavily degraded hillslopes behind. Such policies, however, are continued up to this day.
It is not surprising though, that most villagers lack the motivation to restrain themselves or that they are very reluctant to invest in communal or government lands.

Further, the state induced acceleration of the commercialisation of agriculture brings about several side effects. Now that several products get a cash value, there is a drain of primary products (milk, forestpro-

duce such as Eucalyptus, etc.) away from the village to the (urban) market. The result is a less varied dietary menu for the villagers. Moreover, the cash oriented, short term, state policies undermine the traditional strategies of risk aversion with regard to food security under conditons of drought. Villagers become more dependent on material inputs such as fertilizers, pesticides and seeds. The overall effect is that indigenous agricultural practices, which are based on time-proven principles of sustainability are often left behind.

The villager's rights and obligations in land, and the way in which it is used and the products distributed determines the nature of exploitation of the land. In this respect the villagers' reluctance towards participation in treegrowing is even greater then with regard to communal irrigation management. The latter provides him with the opportunity to get visible returns in the short run, while treegrowing remains a long-term and very uncertain investment. Besides that, the villager knows that the tankwater can not be taken away by external powers, while experiences in the past have proven that there is a real threat that this will happen with the villages' tree-wealth. Also recently the government has shown arbitrariness when it was dealing with the villagers' rights over trees. During interdepartmental shifts in jurisdiction many villagers lost their titles of ownership over trees which they had planted on departmental land. Another example of far going state intervention is the transfer of village commons and other village lands to the Mandal Panchayat. The transfer even included trees which are grown in the village itself. Such developments threaten to increase the villagers' alienation of the treewealth of their village.

Individualisation

The earlier mentioned trend that farmers shift from participation in communal tankirrigation to individucal well-irrigation is a vicious circle. When farmers, who can afford to do so, withdraw from tankirrigation and focus their attention on their private well, they thereby withhold the tankirrigation-organisation their labour and other inputs. In chapter 8 we described how the organisation of tankirrigation in both research villages suffers from the gradual drain of manpower and leadership. The increasing problems with the maintenance of the irrigationsystem forms an extra reason for more and more farmers to invest in private irrigation-wells.

The political and adminstrative culture

We repeat that part of the causes must be sought in the political culture in Karnataka and in the administrative structures and organisational weaknesses.

In summary the external intervention is three-fold:

a: It involves official assistance to villagers by means of departmental extension and the execution of programmes which provide financial (credit, subsidies) and material inputs.
b: The government introduces several political and administrative reforms: reorganisations which aim at greater departmental efficiency or at the promotion of local democratic self-government.

c: The introduction of the new bodies of local self-government (Panchayat Raj) was accompagnied by a further penetration of party politics at the village level.

Ad a: Extension along the lines of the offical paradigms

There are enough reasons to believe that the shift towards private well-irrigation is a state induced development. As we already said, the state encourages farmers to grow cashcrops. Under the present conditions of drought, the cultivation of these, highly water demanding, cashcrops, requires perennial irrigation. Thus a well is a precondition. Secondly, the government holds the paradigm that a rapid spread of irrigation-wells is a solution to the problem of drought (see the seventh 5-year plan).

Ad b: Effects of administrative changes

The probably most dramatic intervention by the state in intra-village relations has been the abolishment of the hereditary village officials in 1959. This created an immense leadership vacuum.
The village officials were replaced by a nomimated Revenue-officer, the Village Accountant and a democratically elected Village Group Panchayat. However, neither the Village Accountant nor the Panchayat fulfilled the supervisory and catalyst role of the former village officials.

Recently the Village Group Panchayat has been replaced by the Mandal Panchayat, a planning cum executive body, composed of representatives of some 22 villages. Together with the Zilla Parishad (the Panchayat Ray body at District level) it has to give shape to local self-government.

At present the village commons and other communal natural resources are getting transferred to the Mandal Panchayat. The legislation on Panchayat Raj furnishes the Mandal Panchayat with important powers with regard to the management of these resources. However, neither in theory nor in practice, proper guidelines and provisions exist which guarantee good maintenance and fair distribution of the proceeds of these recources. Now that the Mandal Panchayat is supposed to contribute to the villager's self determination and to the emancipation of the poor it has first of all to focus on the natural resources which form the very economic basis of the villager. However, the Mandal Panchayats set-up creates many obstacles which hinder the fulfilment of such an important task. The government decided to regroup villages in bigger clusters then under the former Village Group Panchayat, in order to create a viable organisation to the execution of larger decentralised tasks. Because of its scale, villagers face problems with identifying themselves with this abstract institution.

By all means a repeating of serious mistakes made in the past should be avoided. The Mandal Panchayat should not degradate into another institution where the 'politics of distribution' dominate the transactions between the villagers and the government agencies at the Taluk; it will increase the villagers' reliance on and expectations of the government, at the cost of the spirit of self-reliance.

Ad c: Political intervention

In chapter 5 we have stated that the political culture in Karnataka has accelerated the degradation of the natural environment. What we called the 'politics of distribution' has led to a wastage of public resources, such as forests and increased the spoilation of public finances which otherwise could have been invested in environmental restoration. Further, we observed that although a lot of political rhetoric is devoted to the necessity to erradicate poverty, little or no attention is paid to the dramatic consequences of environmental degradation for the living-circumstances of the poor. Politicians prefer to focus on easy obtainable showable successes. They are, for instance a major driving force behind the sharing out of government land and communal village lands, but when it comes to the question of the political sensitive landreforms, they most often remain passive.

The political culture produced new conditions of political patronage which encourage villagers to take an outward-looking attitude, at the cost of the villagers' attention for internal village affairs. The introduction of elections for Panchayat Raj bodies has introduced the party politics in the villages. One can speak of an increased politisation of intra-village relations during the last few years, which in general seems to bring or increase disunity in the villages. For that reason party politics in combination with inter-caste rivalry form another factor which also seems to undermine the cooperation among villagers. Politics introduces alien norms, values and new loyalties to politicians and bureaucrats outside the villags. The new political nature of the patron-client relationship has extended the radius of patronage and shifted the seat of political power from the village to the sub-district (Taluk). At the Taluk headquarters the strategies of the government are converted into action. Local leaders tend to neglect general village affairs, such as conflict arbitration, or the maintenance of the irrigation-system. Increasingly they adopt the role of intermediary: they seek the opportunities to draw government resources to the village for particular clients in return for political support (votes) or economic commissions.

This all in contrast to the nature of the traditional patron-client relationship. The participants in the old, highly unequal though mutual, relationships focused their activities and responsibilities within the bounderies of their direct physical and social environment. The villagers strongly identified with the communal village grounds, with the tank, etc. As all villagers were more or less dependent on these same communal resources, there was an adequat input of manpower for the maintenance of these resources. To some extent the same holds true for the villagers' social relations. The social structure of the village, though devided by caste, class, factions and personal feuds, also offered the villager at least a minimum of social and economic security.

10.3 THE OFFICIAL PROGRAMMES

It must be said that some government institutions have taken the initiative to formulate and execute programs which aim at restoring and preserving the villages' natural environment, such as: the Dry Land Development Board, which developed the so called Watershed Development Programs. Some of these programs are formulated with the intention to solve the problems

of basic needs satisfaction. The Social Forestry Programme which is under execution by the Forest Department is the most important example. However the chosen instruments often prove to be inadeqate. The introduced programmes are often dominated by commercial considerations. For instance: the farm forestry programme is biased in favour of growing eucalyptus trees for the urban and industrial market and does not alleviate the problematic basic needs situation of the poor market. The privatisation of communal grazing lands forms another example: the landless who receive some plots of these lands often have, however, little prospect of cultivating their lands or these are mostly highly degraded; while the landless lack the necessary inputs.

Performance of the government institutions

An even more negative picture takes shape, if one relates the immense size of the involved bureaucratic machineries to the actual performance of these institutions in the field. Beside the Forestry Department, also the functioning of the Irrigation Department can serve as an example. This department gives much attention to medium and major irrigation works and tends to neglect the non-bureaucratically managed minor tanks. We got the impression that it mainly depends on the irrigation-officer in charge, whether or not the villagers can reckon on the assistance of this department for the necessary upkeep of the tanksystem.

As regards the social organisation of the maintenance and utilisation of the tank: besides that well-irrigation increasingly pulls away the necessary manpower, the management also suffers from internal conflicts among farmers, resulting from disputes over waterdistribution and the illegimate undertakings of some members. Again, under such circumstances, the quality of communal natural resource management suffers from the weakening relations of authority and social control. The Irrigation Department falls short in giving the required support to these indigenous tank-management organisations. Furthermore the executive personnel often show a very narrow approach towards their executive tasks. In general these officers seem to lack sufficient feeling with the living conditions of the villagers who form the targetgroup which they are supposed to assist. Not rarely this leads to antagonisms with the village population. The inadequate attitude of these officers can partly be explained by the fact that they form a product of their organisation's administrative culture. Most members receive an in-service training and undergo the socializing effect of the ruling norms and values of their department without receiving new impulses from the outside.

Poverty and environmental degradation

In general the authorities give little consideration to the problem of environmental degradation as the cause of as well as the result of poverty. This is proven by the but minimal share out of the total budget of the government, which is spend on the management of natural resources and by the limited number of schemes and the slow pace of their implementation (see the subsequent 5-year plans).
The debate "who loses and who gains' from a government policy is often couched in conspiration terms; the neglect and harm done to the poor is explained in terms of the hold that the rich have over policy mechanisms and the delivery machinery. While the explanatory power of the social structure is not to be depreciated, administrative failures do not always

stem from class or caste bias, they have their own autonomy (Saxena, 1988: 33).

A succesful implementation of basic needs and environmental conservation programmes requires a high degree of coordination between different departments at the field level. As we already said both in theory and in practice a coordinating framework is missing. In this context we want to highlight the general absence of spatial planning and some sort of Environmental Impact Assessment. The fact that rural poverty is still perceived in pure economics terms and not in terms of access to basic elemens of the natural environment is what we consider to be the sad consequence of political indifference and administrative incapacity.

We realise that this report contains a very grim picture of the state of affaires in rural Karnataka. But the situation is critical. It is true, social-political and administrative reforms and the introduction of new agricultural technologies (green revolution) have thrown off some important positive effects. Nonwithstanding all that, the negligence of ecological side-effects of such external interventions and the lowering quality of local natural resource management means a deterioration of the natural environment, at the expense of the economic situation of the rural population, especially of the poor.

11 RECOMMENDATIONS

Within 5 to 10 years, a disastrous situation will emerge if one fails to work off areas in the planning and in the execution of environmental protection measures. Still, we think, there is much what can be done to counteract this down-going spiral of further environmental degradation and social marginalisation. Therefore we propose the undermentioned recommendations. These suggestions are formulated mainly from an administrative-institutional angle. Existing political and administrative structures and programmes are taken as point of departure. The establishment of new complex and costly personnel structures must be avoided.

Recommendations:

General

1. The villager should be appreciated as the main manager of local atural resources. All official policies should start with him/her, or should at least consider him/her as a major stakeholder.

2. To further develop and execute proper land and watermanagement, the institutional framework must be strenghtened at the village-, regional- and state-level.
   There should be a synthesis of top-down state regulation (through legislation, law-enforcement, planning, budgeting, etc) and bottum-up activities (local people's participation in decisionmaking and execution of both official and non-offical programmes). Often the villager will be the sole decisionmaker, while the formal institutions fulfill only some supportive and regulating functions and further remain in the background.

3. We want to stress the general need for integrated land use planning, accompagnied by improved inter departemental cooperation, doing justice to the interrelationship between the various natural resources. We distinguish two important components:
   I physical ordening;
   II procedures which regulate management and exploitation, and that include on the lowest level the participation of villagers (in decisionmaking processes).

   With the instrument of land-use planning on several levels it is possible:
   a. to check overexploitation and misuse of natural resources (for instance: it is easier to detect and control encroachment and illegimate wateruse);
   b. to achieve a better coordination of the various land-use activities by the government;
   c. to sift out (planned) formal interventions in land use which have adverse impacts from a ecological or social point of view.

4. All undertakings of institutions in the field of land use should be guided by sufficient data on the environmental and social dimensions. To this end the following data should be made available:

I a. An inventory of the natural resources, with special attention for the multi functionality.
b. Data on the carrying capacity of these resources with regard to the present future modes of exploitation.
c. Data under b. should include accurate knowledge of the several ecological and physical-hydrological processes, which should bring to light the important interrelationships between natural resources.

II Data on methods and techniques of management and exploitation, being locally present and making use of the opportunities given by the natural eco-systems.

III The framework of social and economic relations which determine the chances of success of the methods meant under 2. It is necessary that a realistic picture is drawn of how the local social-economic and political powerrelations in the village influence the access of different categories of households to the various natural resources. Insight must be gained about how relationships of authority and cooperation determine the villagers' participation in the management of the natural environment.

IV An analysis of the bottle-necks for basic needs satisfaction of the poorer sections of society and proper exploitation of the natural resources, resulting from existing and forecasted environmental degradation.

5. It should be prevented that indigenous organisation and knowledge get lost. (For instance: the traditional tree planting under the Sanad system, or the still existing custom of dahl-cultivation in the empty tankbed and the use of communally maintained springcanals during the dry season.)

State level policy making

6. The government should shelve its plans to accelerate the introduction of bore-wells and other means of intensive groundwater extraction. Instead the government should concentrate on an integration of rain-fed farming, forestry and wetland farming, taking account of the interrelationship between these land-use types. Soil- and waterpreservation and basic needs satisfaction should be among the main targets of integrated land-use planning at all levels. In this context, there is much to be gained from the expertise being built up during the implementation of the Watershed Development Schemes (alias Dry Land Development Programs). At the village level, the micro plan of the Social Forestry Wing of the Forest Department forms a useful concept.

7. The government should look away from huge investments in new agro-hydrological projects. First of all, attention should be given to the rehabilitation of the immense irrigation potential of the many thousand smaller tanks. many of these tanks suffer from neglect. Their repair and/or desiltation would be a major push towards a strenghtening of sustainable agriculture. Not only such repairments itself, but also the fact that many thousands of hectares of land in the command areas, which now lay barren, but which could then be

irrigated again, mean new employment opportunities for thousands of villagers, for farmers, for agricultural labourers and for those who keep allied occupations.

8. Population growth, landdegradation and further fragmentation of landholdings will inevitably lead to growing landlessness. For the benefit of the poor, we strongly recommend that the government will initiate alternative development options, such as: livestock development, beekeeping, cultivation of small homegardens, alternative crops such as fruittrees, small cottage industries (e.g.: the establishment of small tile or brick factories, which could use the silt from the tankbed as a freely available raw material (such factories should develop its own fuel resources!), basketmaking (the raising of silk worms has drastically increased the demand for bamboo baskets!), fisherys in the tanks, etc.).

9. We stress the necessity that the government provides the Department of Mines and Geology with more strict guidelines in case issuing of licences is continued for bore-wells and other means of mechanised well-irrigation. Such guidelines should consider the hydrological conditions in the location where new wells are proposed, the maximum depth and the maximum number of wells in such location. This requires the formulation of a set of criteria. For this purpose more basic data need to be acquired on the hydrological consequences of well-irrigation.

10. As regards forestry and tree-management: the government should direct its policies towards an increase in clarity about the rights and obligations with regard to trees. Existing land tenure relations should be taken as point of departure. From past experiences can be learned that shifts in land tenure upset tree management as it increases insecurity of people or institutions about their rights over trees and it undermines their sense of responsibility with regard to planting and protection of trees. Therefore farm forestry should be undertaken on private lands, government forestry on Protected or Reserved Forest-lands and community forestry (through community efforts, but with government funds) on common lands.

11. The inmense deforestation problem demands that one is realistic, that one should realise that both individuals and communitees like to produce for markets, but neglect the fuel and fodder needs of the poor. This asks for a new and clear 'division of tasks', would offer better guarantees for basic needs satisfaction and environmental conservation. First of all it is necessary that the government changes it objectives of government forestry. It should do away with the distinction between social forestry and production forestry. Government forestry Reserved and Protected Forest lands should aim at satisfying the welfare and ecological needs rather than producing industrial raw material as now is the case. The production of commercial timber and industrial raw material should be left over to farm forestry and, to a lesser extent, to community forestry (see also Saxena, 1988).

12. That villagers decide to plant fast-growing species like eucalyptus cannot be avoided, but this should not be encouraged by the Forest Department. Moreover, villagers also showed their interest in the

planting trees which produce fruits, seeds, etc, with a high market value like mango and tamarind. The Forestry Department should promote these species.

13. At present the funds for forestry are far from sufficient to balance consumption and production of fodder and fuelwood. We recommend that additional funds are generated for an increase of biomass production in government lands and, where possible, on private and common lands.

Taluk level

14. The Taluk and the District form the core units of planning and executing of land-use management. However, at these levels both the ecological expertise and a special budget is lacking for the development of integrated land-use planning. We strongly recommend that the government nominates high powered 'Environmental Officers' (both at the Taluk and the District level,) who should occupy themselves with planning and coordination activities in this field. Preferable, such officers should be recruited form the Department of Environment (State Government), who will receive special training for this purpose. The Environmental Officers should have substantial financial and personnel support (among other staff-members who are selected and trained for conducting fieldwork) and should kept free from routine administrative tasks. These officials should focus on planning and decision making at Taluk and District level. As regards their official status, one can think of assigning these officers to the respective officers of the Deputy Commissioner and the Commissioner.

15. We recommend the establishment of inter-departmental 'Environment Committees' both at the Taluk and the District level. These committees should be composed of the heads of the various departments who are involved in land- and watermanagement or allied services. These committees should meet frequently (once in two or three weeks) under the chairmanship of the respective Environmental Officers.
The District Environmental Committee should fulfill the role of thinktank. The District Environmental Officer should be nominated as a member of the Zilla Parishad.
We think that the Zilla Parishad can become a driving force behind proper land- and watermanagement, for the following reasons. Firstly, this body is a major channel of finances to land-use and watermanagement programmes (forestry, wasteland development, minor irrigation, etc.). Secondly, we observed that, at District level, the members of the Zilla Parishad tend to take a serious interest in the improvement of the quality of the natural environment. Thirdly, the background of its members (political, bureaucratic, banking world, etc) makes it a nodal institution whose potential should be utilised. Fourthly, it is crucial that the Taluk Environmental Officer receives political support from the Zilla Parishad, in order to lift land-use planning out above the often narrow horizon of local interests.

Mandal panchayat level

16. With regard to local environmental management it should be decided what role would be assigned to, respectively: the informal unregistered organisations, the NGOs and the Mandal Panchayats.

    a. We recommend, where possible, to encourage villagers to develop their institutions into more formal 'Village Natural Resource Management Committees'. Such committees should receive annual fundings from which, for instance, small ad hoc repairs to the tank system can be made, or for the purchase of treeseedlings or grassseeds to develop small fuelwood or fodder plantations. These funds could be channeled through the Mandal Panchayat.
    As regards the committee's status, composition and the way in which the members are elected or nominated, it would be wise to use the experience built up with the village dairy board and the cooperative society. These (semi-government) institutions, which are administered by the villagers themselves, function satisfactory.

    b. The number of well organised NGOs is still rather limited. However, where possible, these organisations should be encouraged to play the role of catalyst and to take the position of intermediary agent between villagers and government institutions. NGOs should be given all the necessary support when they initiate models for sustainable and socially acceptable models for natural resource management. These models can be replicated in other places.
    Especially the grassroot movements are best equiped to create environmental awareness and to mobilise villagers to participate in conservation activities.

    c. The Mandal Panchayat should be encouraged to consider it to be one of their main tasks to look after the preservation of the local natural resource base. In fact this would be the most direct contribution of the Mandal Panchayats to the desired increase of local self government and economic security. However, land-use management at the village level should be looked upon as a result of the villagers' manifest and hidden motives and perceptions. These are determined by complex social structures, formal and informal rights, tenure relations and influences from the wider political and administrative setting. From past experiences can be learned that if one overlooks the villagers' motives and perceptions government policies get frusrated from the start.
    This reality also poses certain limits to the role of the Mandal Panchayat. Though the Mandal Panchayat inhabits a great potential, one should watch not to disregard other local institutions as (more) proper agents of land-use management.
    In some situations it would wise to leave or return exlusive rights and benefits to such institutions, while the Mandal Panchayat takes the role of supporting or intermediary agent (for instance: as the formal channel through which goverment funds can reach such local institutions).

Local natural resource management

17. A professional campaign and corresponding measures to encourage villagers to make a more economic use of scarce fuel and fodder sources (for instance: through the introduction of woodstoves and bio-gass installations and by the promotion of stallfeeding - in order to enable forest and grasslands to regenerate).

18. Social forestry seems to have overemphasized the plantation of trees. The plantation of shrubs and grasses in combination with a periodic closure of the plantatation area would not only be much cheaper but also of greater social relevance to the poor.

19. The promotion of the cultivation of grapes, mulberry, etc. and the plantation of eucalyptus and other fastgrowing treespecies should be carefully examined on their effects from a hydro-ecological and social point of view.

Training

20. It is a serious problem that forest officials are often unable to built up a good relation with the rural population. The same holds true for officers from other departments. This problem can partly be carried back to the fact that the training is inadequate. Further, the number of extension officers is too limited. Morover these officers are in general too much occupied with administrative routine jobs and spend little time in the field.

    We recommend that additional funds are generated to increase the number of extension officials. The decision of the Forest Department to recruit villagers as 'Motivators' is a move in the good direction. Both the staffmembers and the motivators should recieve additional training in extension.

21. Lack of sufficient training forms also a major cause of the incapacity of the landmanaging departments to work out proper modes of inter-departmental cooperation.

    We recommend that staffmembers, besides their proffesional in-service training, also recieve more general training in the social and technical aspects of land-use management. Preferably such training should be carried out by external institutions, for instance by university institutions. The general foresty courses which are developed by the Universtiy of Agriculture (Bangalore) can serve as an example.

22. Now that the Mandal Panchayat and Zilla Parishad are supposed to fulfill major tasks in the planning and execution of land-use managements, their members should be given the opportunity to built up the necessary expertise in this field. For that purpose great priority should be given to the development of short environmental training courses.

GLOSSARY

Bureaucratic-communal irrigation scheme: an irrigation scheme in which the (group of) individual fields are managed by local communities of waterusers and the main system by a bureaucracy. (after Eggink & Ubels and Coward)

Communal irrigation scheme: an irrigation scheme in which the waterusers roles and waterauthority roles are highly integrated as they are guided by similar socio-cultural rules and becuase of the temporal circulation of individuals between the two groups or the simultaneous occupation of roles in both groups. (after Eggink & Ubels and Coward)

Crore: ten million.

Environmental problem: the distortion of the relationship between man and his surrounding natural resources.

Garden: traditionally, those parts in the tank-irrigated commandarea where perennial crops such as fruittrees as well as vegatables are grown. For those places where these traditional gardens disappeared, 'gardens' refer to those parts of the watershed where mainly cashcrops are grown by means of groundwater-exploitation.

Irrigation: the activities related to the harvesting, storage, controlled distribution and application of water to the soil and plants.

Irrigation system: the physical infrastructure to store and divert irrigation water: tank, bund or dam, canals and structures.

Irrigation scheme: the complex made up of the physical infrastructure as well as the related social organization, aimed at realizing irrigation in a certain area. (Eggink & Ubels)

Lack: hundred thousand.

Land Use System: the exploitation of land for particular use, which can be subdivided into two subsystems: land system (climate, soil, relief, hydrology and vegetation) and the utilization system (such as means of production, labour, economical and ecological in- and outputs). (after FAO, 1976).

Mandal Panchayat: lowest body of local self-government (Taluk level).

Man-Nature-System: a system consisting of two components, a) management of nature by man, b) the values and functions of ecosystems.

Natural resources: water, land, living resources and their products.

Natural resource management: the whole complex of exploitation activities, including decisionmaking and organisation of capital, labour and technologies in order to gain products from natural resources through extraction and maintenance.

Neerghanti: a person who is appointed by other villagers to schedule watergifts and to controle waterdistribution within a communal-irrigation scheme. Farmers who make use of the services of the neerghanti have to pay him in kind (compare with Soudi).

Patel: traditional village head.

Shanbogue: traditional village accountant.

Soudi: a person who is appointed by the Irrigation Department to schedule watergifts and to controle waterdistribution within a (bureaucratic-)communal irrigation scheme. He is payed a salary and mostly he is from outside the village (compare with Neerghanti).

Sustainability of local natural resources: the indication to what level of resource exploitation reversibility is not endangered. Furthermore it indicates the exploitation level that does not induce unacceptable changes of the total eco- and landusesystem.

Tank: a valley or depression which is closed by a an earthen or masonry dam or bund in order to create a waterstorage reservoir from which the commandarea can be irrigated.

Tankwater management: the activities (including decisionmaking, planning operation and systemmaintenance) of directing the use of tankwater and the functioning of the irrigationscheme within the commandarea of the tank.

Zilla Parishad: body of local sel-government at district level

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APPENDIX 1 Foundation of Gatlagollahalli

The arrival of the Kavelagowda family and the foundation of Gatlagollahalli is linked to a sensational and legendary story. The K. family used to live in a village some 30 km from Gatlagollahalli. According to the (ex-)Patel (from now on we will call him Patel) the K. family had been forced to flee their native village to avoid death penalty. At that time during a puja (religious festival) for the local goddess Marama a dispute arose between the K. family and the village headman and his clan. People had killed a man and a sheep and hid the corpses in the house of the K. family. Consequently the members of the K. family were accused of murder. The villagers wanted to hang them. Then the Patel's ancestors prayed to the goddess Marama to give proof of their innocence. It is said that the dead man and the sheep thereupon came to live again.
However, the K. family still had to leave the village in order to escape from the headman c.s. who still wanted to kill them. Short after installing themselves in what is presently called Gatlagollahalli they constructed a temple dedicated to Marama. (The temple still exists; it is located near the Bukkapatna tank). The gallow that was erected to hang the members of the K. family, the story continues, grew into a tree under which people still perform puja.
Whatever the value of the legend may be, it explains why the Patels of Gatlagollahalli have always been recruited from the K. family. Having only a moderate landholding compared to the other members of the village elite, the fact that the K. family was the first inhabitant of Gatlagollahalli legitimizes their holding of the office of village headman.

APPENDIX 2

TREES IN THE SURROUNDINGS OF GATLAGOLLAHALLI,
AND IN THE NURSERY OF THE FORESTRY DEPARTMENT

Botanical name	Kannada	fuel	fodder	gr.manure	timber	furn.	agric.im.	fruit	support	shade	fence
PAPILIONACEAE											
Pongamia glabra	honge	x		x			x	oil		x	
Sesbania grandiflora	hagese		x					x			(x)
Glyricidia glabra			x	x							
Erythrina indica	haliwana		x								
Butea monosperma	muthuga									x	
Dalbergia sissoo	honne				x						
Glyricidia sepium	jakku			x							
Delonix regia	gulmoa									x	
Peltophorum pterocarpum	copperpottree										
MIMOSACEAE											
Acacia auriculiformis		x									
Acacia nilotica	jali				x		x				
Acacia concinna	sige (soapnut)							powder			
Albizzia amara	tuggli	x									
Albizzia lebbeck							x				
Acacia javnica		x									x
Pithecellocium dulce	simehunese	x						x		x	
Acacia lutronum	burajali										
Prosopis juliflora	bellary										
CAESALPINACEAE											
Tamarindus indica	hunise	x						x		x	
Cassia fistula	kakke beveru						x				
Cassia siamea	sime tangedi										
Cassia auriculata	tangedi	x									
ARECACEA											
Phoenix sylvestris	ichelo								x		
MYRTACEAE											
Syzygium cumini	jamun	x	(x)		x					x	
Eugenia jambolana	nerale	x	goats		x			x			
Psydium guayava	sibe	x	x					x			
Eucalyptus	nilgiri	x									
URTICACEAE											
Artocarpus integra	halasu/ jackfruit	x			x			x		x	
EUPHORBIACEAE											
Phyllanthus emblica	nelli							x			
Euphorbia	kalli										x
RUBIACEAE											
Tandia dumetorum	kare							x			
RHAMNACEAE								poorly			
Zizyphus xilopyrus	elchi							edible			x

Appendix 2

Botanical name	Kannada	fuel	fodder	gr.manure	timber	furn.	agric.im.	fruit	support	shade	fence
ANACARDIACEAE											
Magnifera indica	mavu/mango	x						x			
Semecarpus anacardium	jidi										
MORINGACEAE											
Moringa oleifera	nugge		x					x			
MORACEAE											
Ficus bengalensis	arali		x			x				x	
Ficus religiosa	banyan		goats							x	
Ficus glamerata	athi	(x)	x		(x)			x		x	
VERBENACEAIE											
Vitex negundo	lakhi	x									
Premna tomentosa	iji							x			
Lantana camera	rotani	x									
SAPOTACEAE											
Medhuca indica	hippe	x	x		x		x	x		x	
MELIACEAE											
Azadirachta indica	bevu/neem	x	x	seeds	x	x	x				
Melia compositae (heterophylla)	hebbevu	x	x		x		x				
MALVACEAE											
Thespesia populnea	vovarsi	x						oil		x	
Cullenia rosayraono	karravi										
LINACEAE											
Erythroxylon monogynum	jivadaldevadaru jivdali	x								x	
SAPINDACEAE											
Dodonea viscosa	bandare	x	x								x
Schleichera deosa	puvathi										
APOCINACEAE											
Vinca rosea	kasiganagali										
COMBRETACEAE											
Terminalia arjuna	mathi				x						
EBENACEAE											
Diospyros melanoxylon	tupra, balai				x						
Achras zapota	sapota							x			
ASDEPIDIACEAE											
Calotropis gigantea	jilledu			paddy							

APPENDIX 3 Example of fodder needs of a buffalo

	quantity	period
green fodder	20 kg silage/day	30 milk days summer
	10 kg silage/day	90 dry days of summer
dry fodder	2 kg/dag	first 30 days of summer
	7 kg/day	remaining 60 dry days of summer
concentrates	1 kg/day	90 dry days of summer
	3 kg/day	30 milk days in summer
dry fodder	3 kg/day	120 milk days in monsoon
	3 kg/day	90 dry days in second monsoon
concentrates	3 kg/day	120 milk days in monsoon
	1 kg/day	90 dry days in second monsoon
	3 kg/day	120 milk days in winter

APPENDIX 4 Eucalyptus

The Eucalyptus tree is an exotic originally introduced from Australia. It is a fast growing species and coppice vigorously. The strong dense wood provides good timber and poles and is an excellent raw material for the fabrication of paper. There is a growing market for this at present abundantly available product.
Nevertheless, the propagation of eucalyptus trees under the Farm Forestry program[1] has come under vehement critisism. (Shiva (1984) and Reddy (1985)):

1. Eucalyptus depletes soil nutrients,
2. it lowers the water table because of its heavy water consumption,
3. it is grown as a monoculture and therefore more vulnerable to a sudden wipe-out by pests or diseases,
4. eucalyptus fulfills fewer functions - such as the provision of fuel and fodder - than traditional trees like Pongamia and Neem; the poor, who are especially dependent on these products, suffer most from this replacement,
5. Eucalyptus allows no undergrowth - consequently a eucalyptus plantation does not yield any fodder,
6. it results in ecological deserts with little fauna, and
7. when grown in the vicinity of crops, it can stunt crop growth.

Forest officials assert that some of the charges against the eucalyptus are justified, but, as they say, that is the problem with any quick-growing tree. By the same token, soil depletion is a negativ side-effect of any monoculture sustained for more than a few years.
Fact is, however, that the authorities did not chose for satisfaction of the basic needs of the poor, but for the interests of industry. Uptil now many questions remain unanswered by satisfactory scientific research.

In 1983 villagers of Gatlagollahalli organized themselves in a Ryat Sangha movement (a farmers' union) to oppose the planting of Eucalyptus by the Forestry Department. In a quite well organized demonstrative action they showed their disagreement with the prevelent forest policies. According to the villagers eucalyptus does not yield the products local people need. Moreover they say the tree plantations are detrimental to crop production, probably through a lowering of the water table and through toxic effects of the tree (roots or leaves?). The villagers expect eucalyptus cultivation to damage the future capacity of the soil to sustain other crops.
Farmers give these same reasons when they are asked why they do not grow eucalyptus on their own fields.

In Kanithalli the situation differs somewhat from Gatlagollahalli. Not only does eucalyptus dominate the forest vegetation, but farmers themselves grow eucalyptus, particularly because it is a profitable tree species. A study by Reddy (1985) makes clear why farm forestry with eucalyptus is so successful in this area. In Kanithalli farmers faced a shortage of labour for dryland-cultivation. (with the enactment of the

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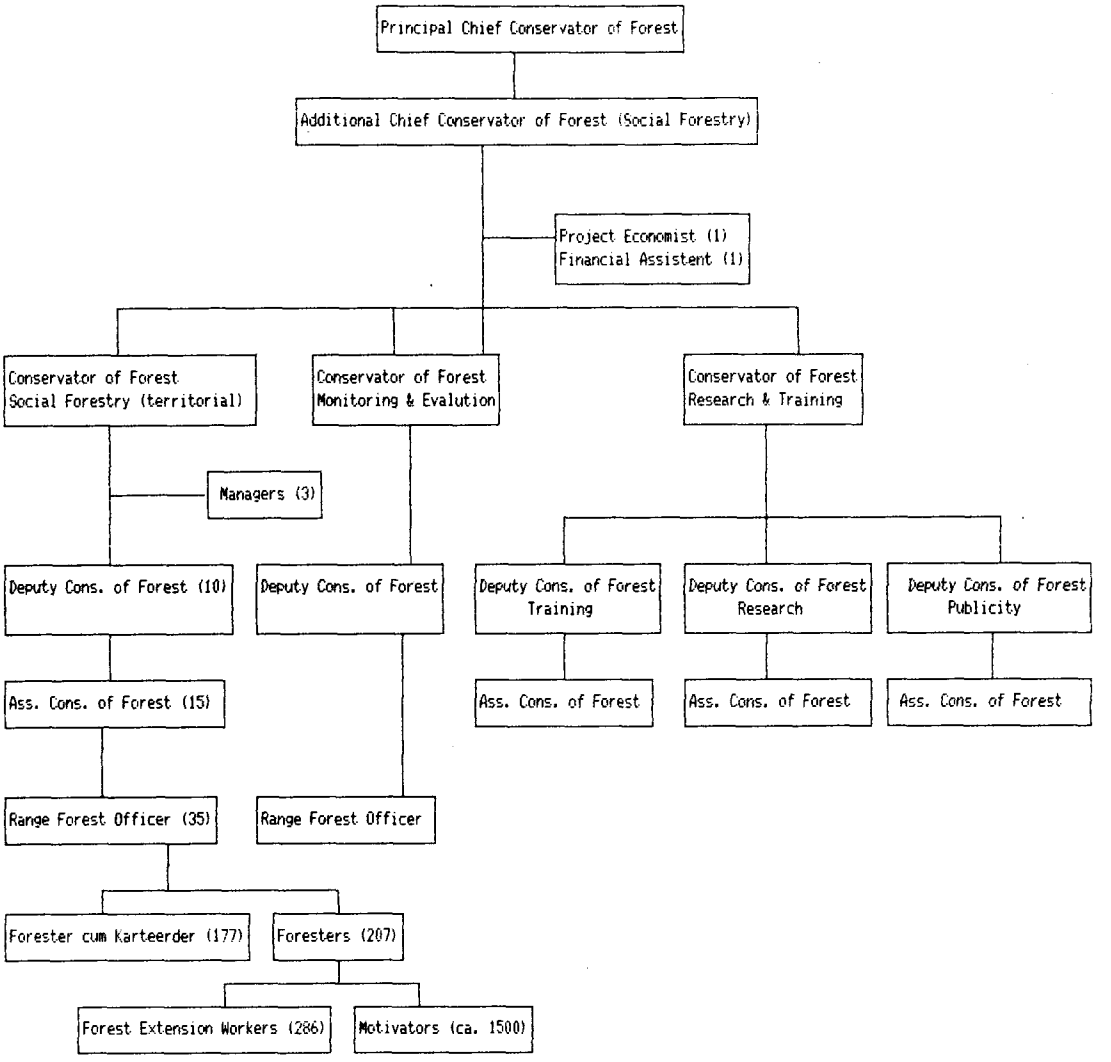
1. Farm Forestry is part of the Social Forestry program of the Karnataka Sate Government started in 1983. By distributing free seedlings, the Forestry Department hopes to incite farmers to plant trees on private lands. So far, Farm Forestry has proved to be the most successful part of the Social Forestry scheme.

Land Reforms Act of 1977 the government has the right to claim any land that has remained uncultivated for three years). The farmers had to find a way to cultivate their lands as otherwise the barren, non-cultivated land would be seized by the government. Growing Eucalyptus was a way to secure ownership rights over "surplus land" and at the same time make reasonable profits with a minimum of labour input (for instance, Halihar-Polybers, the company buying the trees, even did the tree-felling themselves).
In Kanithalli we met only one farmer opposing eucalyptus plantations on the basis of the arguments mentioned above.

APPENDIX 5 Organisationscheme of the Department of Social. Forestry



Assisting personel for all staffs: Clercs, typists, chauffeurs, peons, mechanics, etc.

Several districts in the State of Karnataka, like in most parts of India, are facing an environmental crisis. In this report the causes and social consequences of the two most pressing environmental problems in rural South Karnataka, viz: drought and deforestation, are examined.
This problem of environmental degradation is accompagnied by increasing social marginalisation. It is the survival of the poor which is directly threatened.

The line of reasoning in this report is based on three prepositions. First of all, an understanding of how the protection and the maintenance of local natural resources is organised (e.g.: land-tenure relations, user-rights, the sharing of responsibilities and cooperation) is taken as point of departure. Secondly, that much can be gained when the analysis of the causes of the environmental problems concentrates on the identification and understanding of the changes within the social relations at village level, in particular changes within the structures of authority and cooperation with regard to natural resource management. Thirdly, the various interventions by the external political and administrative institutions are ,among other factors, looked upon as possible underlying forces which produce the social conditions which lead to the lowering quality of local natural resource management.

Using these three assumptions as a general framework, comparative fieldwork was done in two villages during which an assessment of the environmental problems was made by identifying and quantifying the physical degradation and by studying the latter's causes as well as its impact on the basic needs satisfaction of different social-economic categories of households.